Australian Government

Australian Transport Safety Bureau

# Loss of containers overboard from *APL England*

46 NM south-east of Sydney, New South Wales on 24 May 2020


**ATSB Transport Safety Report**

Marine Occurrence Investigation (Defined)

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**Addendum**

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# Executive summary

## What happened

On 24 May 2020, *APL England* was making way down the east coast of New South Wales, with a cargo of containers, bound for Melbourne, Victoria. Early that morning, in adverse weather, the ship underwent a series of heavy rolls that resulted in the loss of 50 containers overboard and shutdown of the main engine.

## What the ATSB found

The ATSB found that *APL England*'s fixed container securing arrangements on deck were in a poor state of repair and the strength of many securing fixtures was severely reduced by corrosion. In the seas encountered, the fittings failed, and containers were lost overboard. The investigation also found that this condition would have taken several years of poor maintenance to develop. This showed that the ship had not received the scrutiny from crewmembers, shore management or other agencies that a ship of its age or condition required. This presented an increased risk to the continued safe operation of the vessel, security of the cargo carried, and safety of crew members working around the containers.

In addition, the investigation found that procedures for adverse weather were not followed. Had these procedures and associated assessment tools been used, navigational and operational decisions could have been made, which would have better prepared the ship for the conditions encountered.

## What has been done as a result

In addition to the repairs conducted on *APL England*, the ATSB has been advised that the deck and container fittings in all other vessels in the APL fleet were inspected and repaired as required. The company also implemented improved vessel inspections and associated reporting requirements for both ship and shore staff.

APL assessed the safe stowage and carriage of high cube containers and conducted an internal safety assessment of the practice. As a result, limits were placed on the numbers of high cube containers that could be loaded into bays fitted with cell guides, which limited the extent to which containers protruded above the cell guides. Cargo securing manuals were reviewed and updated to include the revised stowage arrangements for high cube containers.

Additionally, APL implemented additional safety action regarding passage planning and navigation in heavy weather. They also advised that the wider CMA CGM Group and subsidiary entity fleets were made aware of these issues and the safety actions taken in response to this investigation.

Finally, in July 2022 the classification society, DNV, updated Class Guideline DNV-CG-0182 to include a new section which provided requirements and guidance on the allowable wear and tear of container supporting structures and container securing equipment.

## Safety message

This investigation highlights the importance of regular maintenance of vessel fixtures to ensure the security and stability of the ship and its cargo, as well as crew safety.

Ships' officers and crew are also reminded of the importance of adhering to the cargo securing manual and of following specific procedures and guidance material to assist preparations for, and decision making during, adverse weather conditions.

# Contents

# The occurrence

## Passage to Australia

On 11 May 2020, the 5,780 TEU[1] fully-cellular container ship *APL England* (Figure 1) departed Ningbo, China, bound for Sydney, New South Wales. The ship was loaded with 3,161 containers (5,048 TEU), with a forward draught of 11.44 m, an aft draught of 13.32 m, and a GM[2] of 1.69 m. The Singapore-flagged ship was technically managed by the CMA CGM International Shipping Company Pte. Ltd (CCISC).

The vessel's load computer results based upon ship conditions on departure from Ningbo showed 9 lashing force exceedances, from 102–107% of the maximum force (see the section titled *Load computer*). The master and chief mate accepted these values in the knowledge that changing ship conditions (ballast and fuel) would bring these forces within the acceptable range as the voyage progressed.

On 13 May the master was informed of a change in destination from Sydney to Melbourne, Victoria.

On 22 May, the master received weather advice from the CMA CGM group Fleet Navigation and Support Centre (FNSC) regarding a low pressure system and high swells (5–6 m) developing off the New South Wales coast. The master monitored the weather forecasts via updates from the commercial weather guidance provider ship performance optimization system (SPOS) service.

**Figure 1: *APL England* arriving into Brisbane**


Source: ATSB

On 23 May, at 0800 Eastern Standard Time,[3] the ship was 20 NM north-east of Port Macquarie, making good a speed of 14 knots, in north-westerly winds to force 5[4] (17–21 knots) with 2 m seas on a 2.5 m swell. Over the following hours, the weather deteriorated as the winds moved round to the south and the seas increased. The ship's pitching and rolling motion also increased. The master ordered the ship's speed reduced to about 7 knots as the ship was ahead of schedule into

[1] TEU—twenty-foot equivalent unit—a standard shipping container. The nominal size of a container ship in TEU refers to the number of standard containers it can carry.

[2] GM—Refers to metacentric height, one of the measures used to determine a ship's stability.

[3] All times in this report are east coast Australia local time, Eastern Standard Time (UTC + 10 hours) unless otherwise stated.

[4] The Beaufort scale of wind force, developed in 1805 by Admiral Sir Francis Beaufort, enables sailors to estimate wind speeds through visual observations of sea states.

Melbourne, and advised the officer of the watch (OOW) to use hand steering as required to reduce the motion. The bridge log recorded that all lashings were checked during the afternoon (log entry time 1630).

The master rested from 2030 to 2300 and then returned to the bridge. At midnight, the OOW recorded in the bridge log south-westerly winds to force 9 (41–47 knots), high seas (sea state 7, 6–9 m wave height) on a southerly 4.5 m swell. At about 0100, with intermittent use of hand steering, the master felt the rolling was acceptable and returned to the accommodation to sleep.

The duty engineer completed the evening inspection of the engine room and at 2130 responded to an engine room alarm. The alarm reset when accepted by the duty engineer, who then returned to the accommodation at about 2200 and went to sleep. At 2326, and again at 2347, the engineer responded to alarms sounding, silencing them on each occasion. The engineer found no faults and attributed the alarms to the motion of the ship.

At 0215 on 24 May, when about 40 NM east of Sydney, the ship underwent a series of heavy rolls. Crew members, including the master and the duty engineer were woken by the heavy rolling, and unsecured items moved and fell to the deck. The master went to the bridge where the OOW (second mate) had re-engaged hand steering in response to the significant movement.

Just after being woken, the duty engineer received a telephone request from the OOW to stand by in the engine room. At about that time, an engine room alarm sounded, and the engineer went to the engine room to attend to it. The alarm reset upon accepting.

The heavy rolling dissipated while the ship continued to pitch noticeably. At about 0230, the master changed course more southerly to 195°, and maintained a ship speed of about 7 knots in 40–45 knot winds from ahead (south-westerly). This reduced the ship's motion and the master retired again at about 0300. The duty engineer remained on standby in the engine room and kept watch from the engine control room.

At 0400, the third mate took the navigation watch (OOW), and at about 0420, the master again awoke and returned to the bridge. The ship's course was altered to 185°, and hand steering used as necessary. The master remained on the bridge, and the duty engineer remained in the engine room.

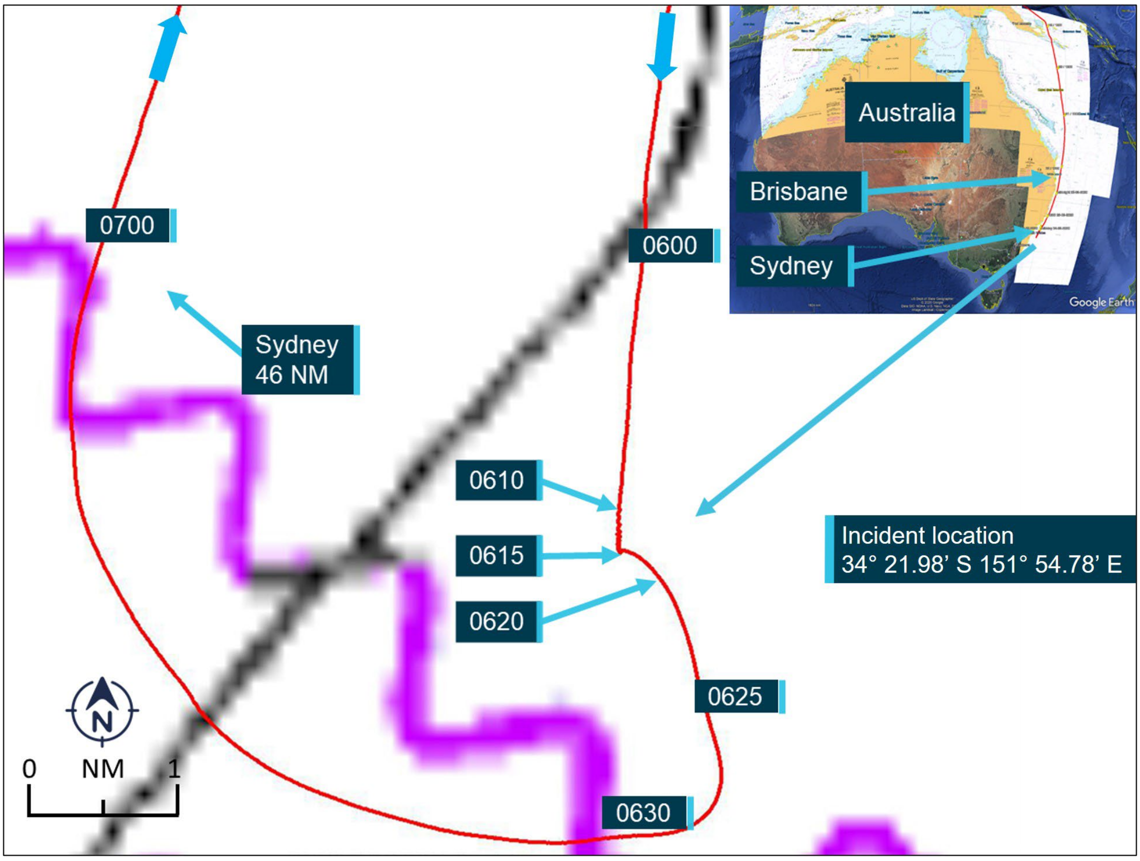
## The incident

Just after 0600, the ship was on hand steering and maintaining its southerly course at about 7 knots (Figure 2). Conditions remained unchanged with the ship pitching and periodically rolling more noticeably in high seas and gale force winds.

At 0610, 46 NM south-east of Sydney, the ship underwent a series of very heavy rolls, to about 25° either side of upright. Again, many items moved and fell to the deck, including those which were previously secure, and personnel held on to maintain their footing.

The movement also resulted in activation of a steering system alarm, followed by an engine room alarm at 0610:28. The duty engineer was seated at the engine control console (near the alarm acknowledge push button) when the heavy roll and alarm occurred. The engineer had to hold on for security and answered the engine alarm 6 seconds after it sounded.

**Figure 2: *APL England* track and incident location**




Source: Australian Hydrographic Office, Google Earth, annotated by the ATSB

The ship continued to roll heavily. At 0610:53, 25 seconds after the initial alarm, the main engine shut down due to loss of engine lubricating oil pressure.

The OOW noted the loss of power and slowing of the ship. They alerted the master to the loss of propulsion and, following standard procedure, moved the engine telegraph to 'stop'.

At 0611:50, the duty engineer informed the OOW that, with the engine telegraph set to 'stop', the engine could be started again once the alarms had cleared and the main engine shutdown lockouts had reset. The main engine was subsequently restarted, dead slow ahead.

The events had woken the chief engineer and the chief mate who both went to the bridge. Upon seeing that the main engine had shut down the chief engineer went to the engine room, while the chief mate took control of navigation to recover the ship.

### *Incident recovery*

The ship was turned easterly and then southerly, into the weather. The response was slow and the main engine speed was increased to half ahead. The ship gathered speed and, by 0617, passed 2 knots and continued turning to starboard and south. At 0622 the ship's speed was 6 knots on a steady 165° heading. The master and chief mate discussed options. It was decided to head north, with the weather, while the situation was assessed further.

The turn to starboard was commenced at 0627 and the ship was steady on a northerly course (about 015°) and with a speed of about 12 knots at 0700. At this time, the ship was 44 NM south-east of Sydney. The chief mate contacted Sydney vessel traffic services (VTS) and was informed that the weather was not expected to improve and that Sydney and Port Botany were closed.[5]

As the skies lightened (sunrise was at 0647), the chief mate noticed fallen stacks of containers aft, from bay 62 (Figure 3 right). The master notified the company of the incident. Upon returning to the bridge about 10 minutes later, the master was further notified by the chief mate of the damage and loss of containers forward at bay 30 (Figure 3 left).

**Figure 3: Looking forward and aft from navigation bridge at about 0700**


Source: APL, annotated by the ATSB

On the northerly heading, though the weather remained unabated from the south-south-west, the ship's movement improved and no further loss of containers occurred. The winds eased to force 7 (28–33 knots) into the afternoon and, at 1600, the ship was passing Newcastle.

Due to the closure of Sydney and nearby ports due to the weather, the decision was made to continue passage to Brisbane, Queensland, the next closest, suitable place of refuge and about 400 NM further north. The weather eased as the ship travelled north. By noon on 25 May, off Byron Bay with 120 NM to travel, winds were force 5 (17–21 knots) from the south-west with sea state 5 (2.5–4 m waves) on a 3 m south-south-easterly swell.

## Brisbane arrival

At about 2136 on 25 May, *APL England* anchored 7 NM off Point Cartwright and the entrance to the Port of Brisbane. Prior to being allowed entry into port, several inspections and assessments by surveyors and maritime authorities were carried out. Maritime Safety Queensland (MSQ) formulated a recovery plan and risk assessment for the operation. Additional piloting, towage, pollution prevention and on-water guidance measures were put in place.

Two days after arriving off the port, at 0600 on 27 May, *APL England* weighed anchor and proceeded into Brisbane. At 1342 the ship was all fast alongside.

Over the following days personnel representing several different stakeholders attended the ship, including investigators from the ATSB, the Australian Maritime Safety Authority (AMSA) and MSQ.

On 29 May, the first damaged container was removed from the ship. In all, 50 containers were lost (16 from bay 62 and 34 from bay 30), and 79 were damaged but remained on board. One container lost overboard contained hazardous goods in the form of dry powder fire extinguishers. AMSA identified a search area of about 1,000 km$^2$ stretching between the Illawarra and Sydney's southern suburbs in water depths of up to 200 m.

5 The ports of Port Kembla, Port Botany, Sydney and Newcastle had been closed to shipping from 22 May due to the weather. The next closest suitable port of refuge was Brisbane.

By 19 June all remaining containers had been discharged and AMSA released *APL England* to sail from Australia to Zhoushan, China, to undertake repairs. On 4 July, *APL England* arrived at the shipyard in Zhoushan.

Post-incident inspections identified that more than 550 single and double lashing plates required replacement, along with significant amounts of deck steelwork and structures. This included lashing plates and structures supporting and securing containers lost overboard. *APL England* underwent repairs and departed the shipyard on 2 August to continue operating. DNV GL placed a condition of class on the ship noting that numerous corroded or thinned bracket/stiffener plates on the exposed weather deck and cross decks remained to be repaired.

Soon thereafter the ship was sold and it changed name, owners, managers, operators, flag, classification society, Protection and Indemnity (P&I) insurers and area of operations.

# Context

## *APL England*

At the time of the incident, *APL England* was owned by CMB Ocean 13 Leasing Company and technically managed by CMA CGM International Shipping Company, both of Singapore. It was chartered by ANL Singapore Pte. Ltd from APL Co Pte. Ltd (APL).[6]

During March 2020, APL changed *APL England*'s voyage plan from the China–India service to the China–Australia service. *APL England* completed the China–India service in Manila and in early April proceeded to Shanghai to load for the Australia service.

The change of service prompted increased attention to the ship's condition (deck and engine room), including deck condition, cargo lashing equipment, access hatches and deck structures as well as other machinery and equipment such as lifeboats, winches and windlasses. Two additional fitters joined the ship to assist with deck repairs and maintenance. Direction was received from, and regular reports were made to, fleet management. A three-day period at anchor to effect repairs and prepare for the change of service was conducted at Shanghai, prior to loading cargo for Australia.

The ship was classed with DNV GL[7] and had completed its most recent annual survey during April 2020.

### *Crew*

*APL England* had a multi-national crew of 25 including two third mates, two cadets and two supernumerary fitters on deck. The master was from Malaysia and the chief engineer from Singapore. Other deck and engineering officers were from China, the cadets from Malaysia and Singapore, the fitters were from Ukraine and remaining crewmembers were from Myanmar. All were suitably qualified, and Singapore endorsed, for the positions they held.

The deck department consisted of the master plus four deck officers (chief mate, second mate and two third mates) and a deck cadet. There was a boatswain (bosun) and three able seafarers, an ordinary seaman and the two additional fitters for deck maintenance. The able seafarers usually maintained bridge watches overnight and assisted the chief mate and bosun on deck during day watches when available. The two fitters had been recently added to the ship's complement to assist with deck maintenance under the direction of the chief mate.

The engineering complement consisted of the chief engineer plus three engineers, an electrical trades officer, a refrigeration engineer, and an engineer cadet plus two oilers and a fitter. The second, third and fourth engineers kept a rotating duty routine in which each engineer was responsible for the engine room operations and alarm monitoring for a 24-hour period every third day, from 0800 to 0800.

*APL England*'s master had worked at sea since 1996 and progressed through the ranks to obtain a Master Mariner's (Class 1) certificate in 2008. The master served in container ships of various size as chief mate from 2007 to 2018 at which time they were promoted to master. This voyage was their second contract in *APL England* and third as master. The master had been on board for 11 weeks.

The chief mate held a Chief Mate certificate of competency obtained in 2016 after first going to sea as cadet in 2008. They had wide experience on container ships up to 8,000 TEU and had been on board for almost 20 weeks having joined *APL England* for the first time in January 2020. The chief mate did not keep a navigation watch.

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6 APL and ANL Singapore are registered and headquartered in Singapore and are part of the CMA CGM Group.

7 On 1 March 2021 DNV GL became DNV.

The third mate was the officer of the watch at the time of the incident. They held a Third Mate certificate of competency obtained in 2018 and had joined *APL England* in December 2019. The third mate's first trip to sea was in 2016 as cadet and all their experience had been in container ships.

The able seafarer on watch and performing helm duties held a certificate of proficiency for rating as an able seafarer—deck, issued in 2016. They first went to sea in 2001 and had joined *APL England* in July 2019. Normal routine was to keep watch during the night (4 to 8 watch) and work on deck during the day watch.

The chief engineer held a marine engineer officer Class 1 (Motorship) certificate obtained in 2016. They had joined the APL fleet as a fourth engineer in 2012 and had since progressed to this, their first, ship as chief engineer. The chief engineer joined *APL England* in March 2020 and had been on board for 11 weeks.

The third engineer was duty engineer at the time of the incident and had first gone to sea in 2010 within the APL fleet. They held a third engineer's certificate of competency obtained in 2016 with all their experience being in container ships with low-speed main engines. The third engineer joined *APL England* in January 2020 and had been on board for 19 weeks.

## Carriage of containers

*APL England* was designed exclusively for the carriage of containers as cargo. Containers were carried in athwartship spaces called 'bays', both on deck and in cargo holds. The ship's bays were numbered from bay 01 forward to bay 62 aft, with bay numbers 45 to 62 located aft of the accommodation.

Containers are stowed and secured with suitable securing arrangements to withstand the forces imposed on them while being transported by sea. The motions of a ship in a seaway give rise to accelerations and forces, the magnitude of which depend upon the dimensions of the ship, its stability conditions and the wind and sea conditions being experienced. A ship's cargo stowage arrangement and securing system is designed to ensure that the forces generated at sea remain within defined, allowable limits and that the container stow remains intact. The ship's cargo securing manual (CSM) provided details of these limits, stowage arrangements and container securing systems, including lashing patterns and details of lashing gear.

On board *APL England*, the equipment used to secure containers on deck included twistlocks, lashing bars and turnbuckles. Twistlocks were used to secure containers stowed on deck to the hatch cover or deck, and to secure containers to one another vertically in a stack. Turnbuckles were anchored to lashing eyes on the ship's deck, hatch coaming or lashing bridge, depending on the location on board. The lashing bars secured containers to the ship and were tensioned via the turnbuckles.

## Container securing

SOLAS[8] required that, in part:

> Cargo…carried on or under deck shall be so loaded, stowed and secured as to prevent as far as is practicable, throughout the voyage, damage or hazard to the ship and the persons on board, and loss of cargo overboard.
>
> All cargoes…shall be loaded, stowed and secured throughout the voyage in accordance with the Cargo Securing Manual approved by the Administration. The Cargo Securing Manual shall be drawn up to a standard at least equivalent to relevant guidelines[9] developed by the Organization (IMO).

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[8] The International Convention for the Safety of Life at Sea, 1974, as amended.

[9] Refer to MSC.1/Circ.1353: Revised guidelines for the preparation of the cargo securing manual.

The ‘relevant guidelines’ required that the CSM covered all necessary aspects of cargo stowage and securing and had uniform layout and content. Consistent with this guidance, *APL England*’s CSM included the following general information, that:

- the CSM specified the arrangements and cargo securing devices provided on board the ship for the correct application to and the securing of…containers…based on transverse, longitudinal and vertical forces which may arise during adverse weather and sea conditions
- it is imperative to the safety of the ship and the protection of the cargo and personnel that the securing of the cargo is carried out properly and that only appropriate securing points or fittings should be used for cargo securing
- information on the strength, and instructions for the use and maintenance, of each specific type of cargo securing device, is provided in this manual
- cargo securing devices should be maintained in a satisfactory condition (and) items worn or damaged to such an extent that their quality is impaired should be replaced.

In accordance with requirements, *APL England*’s cargo securing manual was compiled by Kunshan Lucky Sea Industrial and first approved in 2001. The CSM in force at the time was approved, with amendments, by Class (DNV GL) on behalf of the Republic of Singapore Flag Administration on 15 May 2017.

## *Fixed container securing devices*

Chapter 2 of the CSM provided details on the fixed securing devices used on deck which included 1,500 lashing plates—686 single, 686 double and 128 swivel. Each lashing plate had a safe working load of 250 kN and a breaking load of 500 kN. The single and double lashing plates were welded to the ship’s structure and were made from 25 mm thick steel plate (Figure 4).

**Figure 4: Lashing plates (eyes), spare and as recently fitted to *APL England***

Source: ATSB

## *Maintenance of securing equipment*

Sound engineering practice, prudent seamanship and multiple industry and business guides, circulars and directives dictate that it is important that shipboard equipment, such as cargo securing devices, meet acceptable functional and strength criteria applicable to the ship and its cargo. Additionally, (as detailed above in the CSM) such devices should be maintained in a satisfactory condition and items worn or damaged to such an extent that their quality is impaired should be replaced.

Chapter 2.3 of *APL England*’s CSM described the inspection and maintenance requirements for the fixed and portable securing equipment. This section included the following information:

> Inspection and maintenance of both fixed and portable securing gear should be carried out under the responsibility of the master…at intervals not exceeding six months…and…should be documented in an appropriate record book, which should be kept with the Cargo Securing Manual.
>
> Damage to fixed cargo securing devices must be repaired by an authorized workshop and reported at the next suitable survey of the classification society.
>
> During the voyage…inspection and adjustment of securing arrangements…is limited to moderately retensioning turnbuckles of lashings. This is particularly important when heavy weather or swell is being expected.

Additional remarks included:

> …where there is any doubt over the capability of existing fixed securing arrangements including supporting structure, the fixed fitting should be proof tested at loads equal to the maximum specified securing load + 25%. The proof loading is to be applied at both the mean and extreme angles of operation.

DNV GL advised that, at the time of the occurrence, there were no class rules specifically for the wear and tear and corrosion of fixed lashing devices. Rather, assessment of acceptable wastage was based on class standards for lifting appliances.[10] That allowed for 10% reduction in plate thickness due to wear and tear and general corrosion, and 30% in the case of isolated pitting.

Appendix VII of the CSM contained the 'Record of cargo securing devices inspection and maintenance'. This included third party service reports and a section listing on board inspections. An ATSB review of these records identified that they were intermittent and inconsistent, particularly after 2014. The latest entries were from monthly inspections January to April 2020. All lashing gear was considered in 'satisfactory' condition with limited comments which included 'Lashing eye found corrosive (sic)'. Prior to 2020, the preceding record was from October 2016.

No planned maintenance system or other digital or other record of fixed and portable lashing equipment inspection and maintenance was provided to the ATSB by the master or APL.

### *Container forces*

The CSM in addressing stowage and securing and the forces acting on containers remarked:

> - The stowage and securing system as described in [this manual] is designed under the condition of GM ≤1.5 m.[11] If, for any reason, the ship is to be operated with larger GM values, the expected acceleration will increase accordingly.
> - If a GM value greater than 1.5 m cannot be avoided a reduction of stack masses or stack heights…or a shifting of masses to lower tiers in the stack should be effected.

*APL England*'s container stowage and securing arrangement was designed so that forces remained within the maximum allowable limits. The preparation and approval of the container securing arrangement plan and the lashing computer system was based upon DNV GL 2017 rules which were in turn based upon and similar to the Germanischer Lloyd (GL) 'Guidelines for Loading Computer Systems 2013' (GL2013) rules.

DNV GL documents relating to container ships and stowage and lashing of containers outlined the forces calculations and the static and dynamic variables used. These variables included:

- static gravity forces—container weight; stack weight
- dynamic, inertial forces generated by accelerations due to roll, pitch and heave motions of the ship—the calculations took into consideration ship's speed, stability condition (GM) and trading route, combined with statistical wave data according to IACS recommendations[12]
- wind forces

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[10] DNV GL standard DNVGL-ST-0377 Shipboard lifting appliances

[11] *APL England*'s GM on departure Ningbo was 1.69 m and calculated at noon 23 May was 1.61 m.

[12] International Association of Classification Societies (IACS) recommendation No.34 Standard Wave Data

- wave impact forces from seas
- forces imposed by the securing arrangements
- strength of the container and of the lashing equipment including ship's structure.

The DNV GL method used roll, pitch and sway to determine a roll motion (transverse) acceleration for each loading condition. A minimum heeling angle of 16° and maximum of 21.4° were used to calculate the maximum transverse acceleration. The maximum expected heeling angle for the load condition (taking into consideration vessel speed, stability condition and route) was then calculated.

All calculations were based upon lashing equipment in new condition with a factor of safety of 2 (failure strength 2 times the design load) to allow for corrosion and wear and tear.

## *Non-standard height (high cube) containers*

The CSM provided guidance on securing of all containers approved for use on board. To this end the CSM made specific reference to the various size containers the ship could carry, and which type of container could be carried in which location on the ship. Therefore, multiple references were made throughout section '*4.3 Container stowage and securing plans*' to the size (length and height) of container to which each plan applied. The summary page of the plans listed 20 ft and 40 ft containers as being International Organization for Standardization (ISO) standard 8 ft 6 in high units. Taller containers (high cube)[13] were limited to the longer (45 ft, 48 ft and 53 ft) containers.

The plans for 40 ft container stowage on deck each noted a height of 8 ft 6 in for 40 ft containers. The CSM only allowed for 40 ft containers to be loaded into bay 62 and did not allow for these to be high cube containers.

The CSM further stated:

> - The mass distribution within bays and stacks as stated in this manual presents an optimum under the given circumstances. Any alteration of this distribution will have an effect to the magnitude and distribution of forces in containers and securing devices.
> - In deciding on another vertical distribution of masses in a stack the relevant distribution as given in this manual should be taken as a reference (and in that case) the following principles should be used (including):
>
> When stacking 9' 6" containers a reduction of top masses or a shifting of masses from top to bottom should be carried out in order to compensate for the higher center of gravity and the higher windage area of that stack.

## *Cell guides*

*APL England* was fitted with cell guides[14] for on deck stowage of containers into the aftmost bay (bay 62). According to DNV GL rules, containers stowed within cell guides on deck were considered as though they were stowed in cell guides below deck and needed to comply with those rules. The rules allowed for athwartships clearance of 25 mm and fore-aft clearance of 38 mm.

The support provided by cell guides was not allowed for in DNV GL (GL2013) forces calculations (see the section titled *Load computer*) for container securing.

Manufacturers of the MACS3 loading computer advised that the program assumed all containers with the bottom within the cell guides did not have twistlocks fitted and those above the guides did. The program assumed all containers loaded into bay 62 were standard 40 ft (8 ft 6 in high) with twistlocks fitted between tiers 5 and 6 and above. Furthermore, program forces calculations

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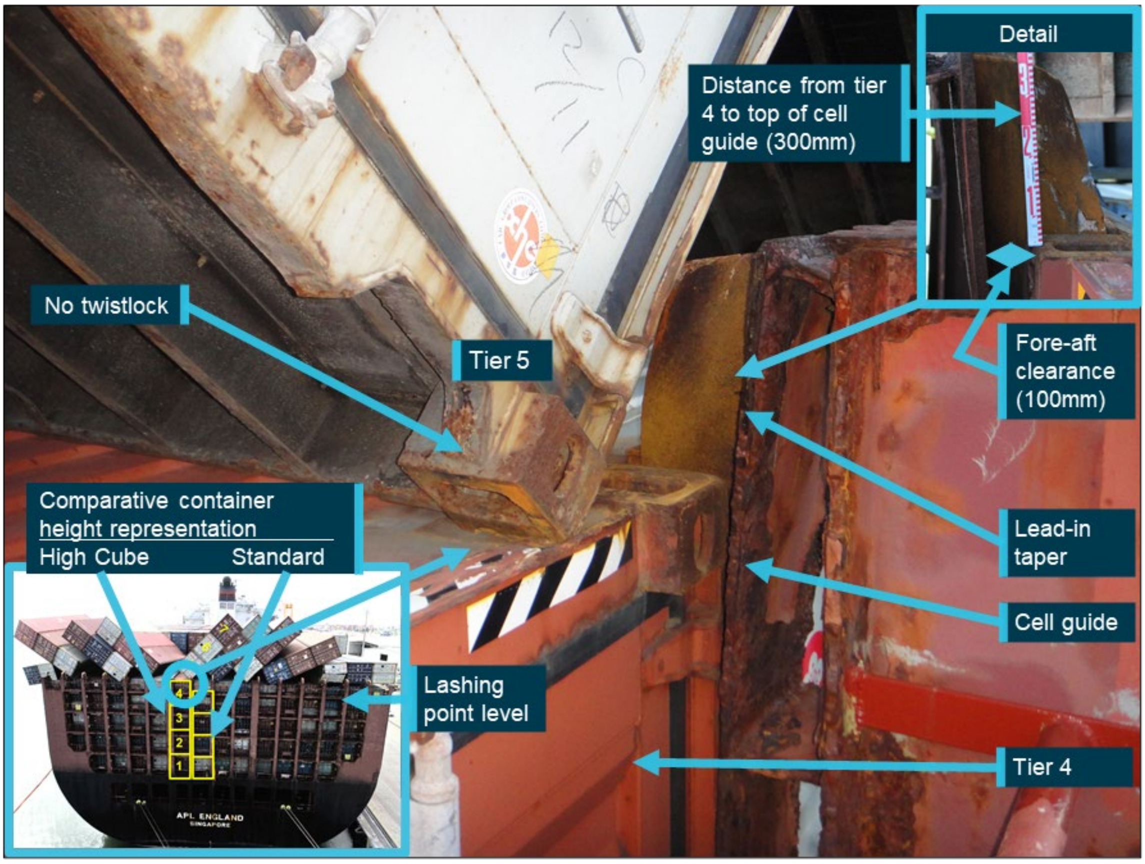
[13] High cube containers are ISO standard sized (length and width) containers with a height of 9 ft 6 in

[14] Cell guides are an arrangement in holds or on deck of fixed vertical guide rails for support of containers

assumed that all containers with their base within the cell guides were completely covered (supported) by the cell guides.

Contrary to the CSM requirements, *APL England* was loaded with exclusively high cube containers into bay 62. The top of tier 4 was therefore 1.2 m higher than if standard height containers had been loaded (Figure 5). This reduced the amount of the tier 5 containers held within the cell guides although the loading computer program considered them to be completely within.

**Figure 5: Bay 62 container stowage versus cell guide arrangement**




Source: ATSB

### *Container securing arrangement document*

The CSM was supported by a Class approved (DNV GL 15 May 2018) 'Container securing arrangement' (CSA) document which outlined the stowage and securing arrangements for the vessel for each location and for each size of container carried. The information in this document was similar to that contained in Chapter 4.3 (Container stowage and securing plan) of the CSM. However, there were notable differences between the information provided in the CSM2017 and CSA2018, especially regarding numbers of tiers, container and stack weights and lashing of forward bays. It was not apparent which of these two documents was the definitive one upon which the cargo loading and securing plan was based, or upon which the settings for the load computer were based.

This document agreed with the CSM in defining 40 ft containers to be standard height, with no reference to 40 ft containers of different heights for loading throughout the ship, including bay 62.

## Load computer

The CSM, in addressing stowage and securing and the forces acting on containers remarked:

> In the light of the complexity of the problem of proper stowage and securing of containers with varying gross masses under the usual condition of time pressure in port it is strongly recommended to ship owners or ship operators to provide appropriate computer software in order to enable ship's staff to keep the securing of individual loading situations under control.

*APL England* had a capacity of 5,780 TEU. With limited durations in port for cargo operations, a means to easily and quickly ascertain that the forces acting on the ship would not exceed specified limits was required. Therefore, in addition to the CSM, the ship was fitted with a Seacos MACS3 (v NET1.1) loading computer system developed by Interschalt Maritime Systems. Among other applications, this system also incorporated a container or cargo loading module and a lashing calculation program. The system met the requirements of the GL2013 rules.

A loading computer alone does not meet the SOLAS requirements for a CSM approved by the Administration. Consequently, DNV GL rules stated that

> An approved loading computer system is not a substitute for the approved loading manual, (or) the approved stability booklet…It is used as a supplement to these approved documents to facilitate strength and stability calculations.

## *System functions*

The MACS3 system utilized a wide range of hydrostatic, stability and strength calculations to assist the safe loading and unloading of the ship. The system was also capable of assessments of stability and stress conditions throughout a voyage.

Among other features, the MACS3 program included the Sealash cargo securing module. This module checked and analysed lashing forces. It was also capable of inventory management for the securing materials.

The software combined details of the ship's structure, securing arrangements (equipment and securing methods), container weights and distribution (sourced from load condition files delivered to the ship prior to loading), and ship condition in calculations. Many of these details were unable to be changed by the user and were based on classification society requirements.

However, some parameters which influenced the lashing forces calculation results, were able to be changed by the user. This included GM, draught and speed.

The load computer generated a coded bay plan for each bay which displayed relevant container details including position (bay, row and tier numbers), container serial number, size, weight, class of dangerous goods (if relevant), load and discharge port. All information was also available in tabular format.

The graphical plan also showed the lashing arrangement. Each page of the plan included tabulated figures on stack weight and forces calculated for each stack. Exceedances were highlighted in red.

## *Non-standard cargo containers—high cube*

High cube containers were indicated in bay plans by a dark triangle on the upper right corner of the software's graphical image. The difference in height between standard and high cube containers was visible, as the container representation was also higher. Further, the overall stack height would appear higher on the bay plan graphic.

Loading of high cube containers into bay 62 was in contravention of the CSM. However, no error messages were displayed on board *APL England* for this loading condition.

The APL cargo operations manual included a procedure for 'Lashing system—loading restriction'. This procedure highlighted height restrictions for full stacks of high cube containers below the lashing level (as per bay 62). This procedure described that, upon starting the MACS3 software, a pop-up warning window would display directing the user to refer to the CSM and that 'when loading containers on deck…it is compulsory to stow particular amount of standard or high cube containers on tiers 80 to 86 (tiers 1 to 4 on deck) as per the Cargo Securing Manual'. This document was dated 6 April 2020, however the required warning was not displayed on the *APL England* loading system software.

No explanation was provided in relation to how the high cube containers were permitted to be loaded into bay 62 or why the MACS3 software allowed this breach of the CSM.

## Machinery

*APL England*'s main engine was a Samsung B&W 12K90MC, delivering 55,659 kW at 94 revolutions per minute (RPM) through a direct drive six-bladed propeller. At 94 RPM the main engine consumed 210 tonnes of fuel per day at a ship speed of 25 knots. Economical speed was 60 RPM, consuming 67.7 tonnes of fuel per day at 16.3 knots.

The main engine lubricating oil system included two vertical centrifugal pumps with 400 mm delivery bore and 1,200 $m^3$/hour capacity at 0.45 MPa pressure. The pumps were mounted into the lubricating oil sump tank at the forward end of the main engine. Minimum oil level in the sump tank was 480 mm maintaining the pump suction submersed by 350 mm. Records of sump level showed that the engine was being operated with oil levels within recommended parameters.

In accord with DNV GL rules, the system was designed to operate in dynamic conditions to up to 22.5° roll and 7.5° pitch angles.

The main engine lubricating oil system pressure monitoring consisted of two pressure sensing circuits. The first was a pressure transducer which provided real-time pressure values to the engine room alarm and monitoring computer system. The monitoring system provided a display of oil pressure in the machinery control room. Normal inlet pressure to the engine was 0.27 MPa. Software alarm and shutdown triggers were based upon readings from this transducer. A separate pressure switch was also fitted as an independent low-low pressure main engine shutdown. The software low pressure alarm was set at 0.17 MPa with zero-time delay, and both low-low pressure shutdowns were set to 0.15 MPa with zero-time delay.

## Recorded data

### *Voyage data recordings*

*APL England* was fitted with a simplified voyage data recorder (S-VDR)[15] designed to collect and store data from various shipboard systems in compliance with SOLAS requirements. This included parametric data, bridge and communication audio, and radar images. Roll and pitch data were not recorded on board, nor was there any requirement to do so.

*APL England*'s system was designed to capture 12 hours of data, written concurrently to a Compact Flash (CF) card and the protective capsule. This system required crew interaction to ensure the data was saved following an incident where power was not lost. The oldest data was continually overwritten and to preserve data, it was saved to the CF card and the card removed. This procedure was followed on this occasion and the recorded data was provided to the ATSB. The downloaded data was successfully converted into a usable format in accordance with the manufacturer's procedures.

*APL England* was also fitted with a Panasonic video recording system, which captured 8 video feeds from cargo areas and the bridge, and contained about 1 month of data. The video recordings were viewed as part of the investigation but did not capture the loss of containers overboard.

[15] The voyage data recorder for a cargo ship larger than 3,000 gross tons, constructed before July 2002 may be an S-VDR.

## *Machinery alarm log*

*APL England*'s machinery control, monitoring and alarm system provided a record of alarm activations. This system was independent of the VDR and analysis showed the alarm time stamp to be 2 minutes and 43 seconds ahead of the times recorded on the VDR. Times were captured for alarm activation, acknowledgement and clearance.

## *Recorded data*

Data from the time of the heavy rolling and loss of containers are shown in Table 1 and Figure 6.

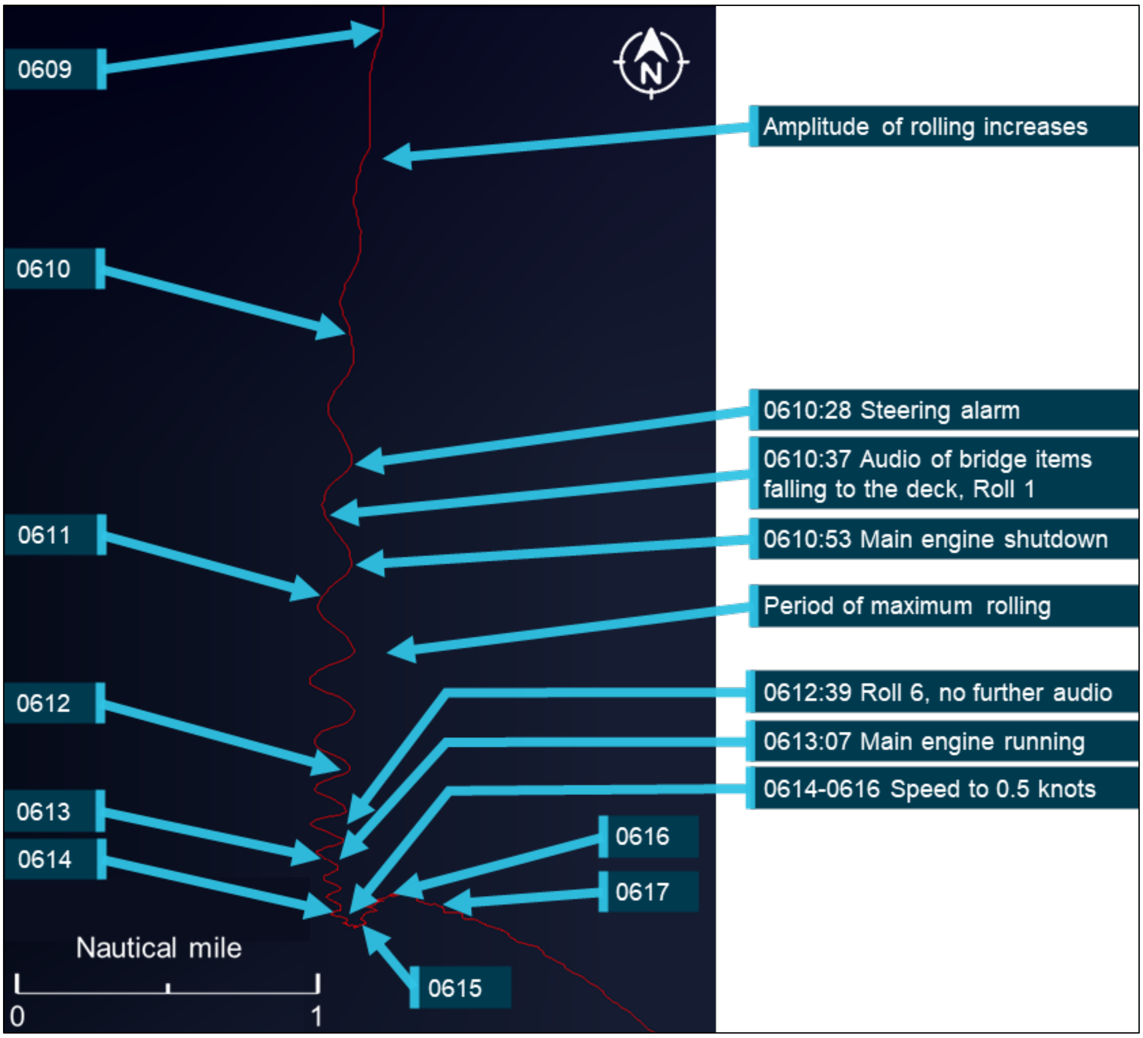
**Table 1: Recorded data times and events from the time of the container loss overboard**

| Time (Local, VDR time) | Event |
|---|---|
| 0609 | Rolling begins to increase, ship speed about 7 knots |
| 0610:28 | Steering system alarm |
| 0610:28 | First machinery alarm since 0218—piston cooling oil inlet low pressure[1] |
| 0610:37 | Roll 1—audio of objects within the bridge sliding and falling to the deck[2] |
| 0610:50 | Roll 1 return—sliding and banging audio of objects within the bridge |
| 0610:53 | Main engine shutdown alarm |
| 0610:59 | Roll 2—audio |
| 0611:04 | OOW and master note that the main engine had stopped. Ship speed slowed to about 5 knots |
| 0611:08 | Roll 2 return—audio |
| 0611:18 | Roll 3—heavy sustained roll audio. Period of maximum rolling |
| 0611:29 | Roll 3 return—sustained audio |
| 0611:41 | Roll 4 |
| 0611:55 | Roll 4 return |
| 0612:06 | Roll 5. Ship speed to 3.5 knots |
| 0612:14 | Main engine shutdown interlocks reset |
| 0612:18 | Roll 5 return |
| 0612:30 | Roll 6 |
| 0612:39 | Roll 6 return, no further sliding or falling object audio |
| 0612:46 | Public address warning |
| 0613 | Ship speed to less than 2 knots |
| 0613:07 | Main engine slowdown alarm indicating the engine was running |
| 0614 to 0615 | Slowest speeds of about 0.5 knots recorded |
| 0615:24 | Master confirmed main engine was running |
| 0615:41 | Speed of 1 knot audibly confirmed |
| 0617 | Speed increases through 2 knots |

[1] The duty engineer had changed the machinery alarm duty call system to 'Attended' and alarms were not sounding on the bridge or recorded by VDR audio

[2] References in this table to audio are to objects within the bridge sliding and falling to the deck. No audio of containers falling was recorded

**Figure 6: *APL England*'s track from 0609 with times and events marked**




*Track waviness is related to the port-starboard motion of the GPS sensor (mounted about 25 m above the waterline) as the ship rolled. Annotation 0610:37 falling objects refers to audio of objects within the bridge falling to the deck, not external audio of containers falling.*
Source: Google Earth, with APL data, annotated by ATSB

The data showed that the rolling preceded the main engine shutdown and reached maximum as, or just after, the main engine stopped. The rolling then quickly diminished as the ship slowed and propulsion was re-established. No audio, or other recording, captured the moment the containers fell overboard.

## Ship inspection

General guidance in SOLAS (Chapter 1 Regulation 11) stated:

> (a) The condition of the ship and its equipment shall be maintained to conform with the provisions of the present regulations to ensure that the ship in all respects will remain fit to proceed to sea without danger to the ship or persons on board.

Additional references and IMO circulars[16] supported and expanded on this principle.

Multiple organisations and agencies have an interest in the condition of ships within their sphere of influence. These entities thus have roles, responsibilities and obligations when it comes to ensuring that the ship is safe to operate and is fit for service. Typically, the list of interested parties includes the:

[16] See, for example, MSC/Circ.1070—Ship design, construction, repair and maintenance

- shipping company
- flag administration
- classification society
- protection and indemnity insurance (P&I Club)
- coastal and port States within the area of operation of the ship.

## *Shipping company and shipboard (APL)*

The ISM Code[17] (Part A, paragraph 10) makes it clear that the ship operator (the shipping company) is responsible for ensuring the safe and pollution-free operation of the ship. In particular, the shipping company is required to ensure that the ship is maintained and operated in accordance with applicable rules and regulations and any additional requirements that may be established by the company.

Maintenance for control of corrosion of deck fittings is difficult and is heavily reliant upon good inspection regimes. APL had a planned maintenance system, and survey and inspection cycle in operation throughout its fleet. Part of this regime included regular vessel visits and inspections by shore management and technical staff along with routine vessel management contact and practices.

Records of these visits and inspections included:

- a vessel maintenance planning spreadsheet (referred to as the Fleet 077 document). The latest spreadsheet prior to the incident (updated 24 May) contained 229 jobs, 53 of which remained outstanding. While this list contained many jobs related to repair of corroded deck fittings (including lashing bridges), no jobs existed for repair of cargo securing arrangements such as lashing eyes or container foundations.
- chief mate handover notes (from 11 January 2020) providing an exchange of information between departing and boarding crewmembers regarding job relevant information including deck maintenance. This document referred the reader to the Fleet 077 list and made particular mention of renewal of container foundations by the deck fitters.
- chief mate's deck maintenance prior to arrival in Australia list compiled as part of routine duties—undated, unsigned. This list contained mention of 50 lashing eyes and 200 container foundations requiring replacement and said to be included in the dry dock list. In addition to this list, correspondence from the previous chief mate to shore management reported a total of 270 container foundations requiring replacement.
- an undated dry dock list provided details of shipboard maintenance which could only be, or would be more appropriately, completed when the ship was out of service and/or out of the water. The dry dock list included 276 lashing eyes and 270 container foundations along with lashing bridge structures requiring repair or replacement. *APL England*'s next scheduled dry docking was due by early 2021.
- the cargo securing manual contained a sporadic manual record of cargo securing gear maintenance. The records contained therein included monthly entries for 2020. These entries included comments that lashing eyes were found corroded and damaged container foundations had been repaired.

APL did not provide detail of the history of shore management inspections of *APL England*.

### *Change of service preparations*

Prior to loading cargo for the change of service to Australia, *APL England* proceeded to anchorage for 3 days and undertook repairs. This repair time was to address items related to the

[17] International Management Code for the Safe Operation of Ships and for Pollution Prevention.

recent detention of another company vessel in Australia, however it did not include any inspection or maintenance of cargo securing equipment.

## *Flag administration (Singapore)*

Responsibility for the safety of a ship and compliance to relevant international instruments rests with the flag State, as provided under Article 94 of the United Nations Convention on the Law of the Sea (UNCLOS).

As part of the discharge of its obligations and to ensure compliance with flag requirements, the Maritime and Port Authority (MPA) of Singapore conducts flag state control (FSC) monitoring and inspection on all Singapore-registered ships. The MPA advised the ATSB that *APL England* was generally inspected every 4-5 months with the last inspection carried out on 18 March 2019. The advice went on to say, that apart from some common deficiencies, the vessel was generally well-maintained with no deficiencies related to cargo securing devices.

## *Port state inspections*

International conventions and the UNCLOS give nations responsibilities to check and control ships in coastal waters so that they do not pose threats to ship and crew safety or to the marine environment. These countries utilise port state control (PSC) as a method to ensure shipowners and flag states comply with their responsibilities for the safety and operation of a ship.

*APL England* first entered service in 2001. From then, until this incident, the ship had been subjected to at least 50 separate port state inspections. No detentions were recorded and while deficiencies were regularly recorded from 2013 onwards, only one deficiency (in 2016) related to lashing material.

The last PSC inspection was completed in December 2019, with one minor deficiency recorded.

As part of the PSC operations, port states and collectives of port states (under various geographical memoranda of understanding) periodically conduct inspection campaigns targeted (or focused) at particular areas of concern. Several of these campaigns have been directed toward cargo securing including container ships and container securing. The results from campaigns conducted world-wide since 2016, including by MOUs in *APL England*'s areas of operation,[18] did not highlight fixed cargo securing arrangements as an area of concern.

### *Australian Maritime Safety Authority port state control inspections*

In Australia, the Australian Maritime Safety Authority (AMSA) conducts PSC inspections. AMSA figures for 2020 showed:

- 26,179 ship arrivals into Australian ports (5,981 individual ships), 3,694 container ship visits
- 3,021 PSC inspections,
  - 6,377 deficiencies—2.1 per ship inspection
  - 178 ships detained
- 263 inspections of container ships (8.7% of total)
  - 879 container ship deficiencies, 3.3 per inspection, 436 deficiencies were structural/equipment related
  - 17 container ships detained
- 295 Singapore flagged ships were inspected with 13 being detained
- 519 DNV GL vessels inspected, 1,182 deficiencies, 30 detentions.

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18 Tokyo MOU—21 member organisations in the Asia-Pacific region, including Australia
Indian Ocean MOU—20 member countries in the Indian Ocean region, including Australia

### AMSA Marine Notice 03/2018 Proper stowage of cargo containers

Australia expects cargo to be carried in full compliance with a vessel's CSM and in accordance with the requirements of the SOLAS Convention. In 2018 AMSA published Marine Notice 03/2018 'Proper stowage of cargo containers'.[19] This notice reminded vessel owners, operators and masters of the need to stow and secure cargo containers in accordance with approved arrangements.

The notice revealed that AMSA was aware of recent incidents in which the stowage of cargoes did not comply with the approved arrangements, including that fixed and portable securing equipment were not maintained appropriately.

### AMSA focused inspection campaigns

In 2010, AMSA conducted a focused inspection campaign (FIC)[20] into securing arrangements of cargo containers. That campaign found that, of 111 vessels inspected, 8% of the vessels inspected had container lashings and fittings that were in a condition which was a cause of concern. Further, 10% of the vessels recorded deficiencies in relation to containers not lashed in accordance with the vessel's CSM.

In 2020, following this occurrence, AMSA conducted a FIC on proper stowage and securing of cargo containers. This was to verify that containerised cargo was stowed and secured in accordance with SOLAS. Over a 3-month period, AMSA conducted a total of 208 FIC inspections. Results from the campaign included that 'fixed cargo securing equipment (was) in good condition'. Two ships were detained as a direct result of the FIC, neither for condition of fixed securing devices nor deck condition.

The FIC web report included the observation that:

> Since the campaign, AMSA has continued to observe failures of fixed physical securing arrangements onboard ships visiting Australia.

In May 2021, AMSA detained the container ship *Sealand Michigan* for, among other items, the deficiency 'Fixed cargo securing devices corroded and defective.' This ship was of similar age and size to *APL England*.

### AMSA maritime safety awareness bulletin

In March 2021, AMSA published marine safety awareness bulletin number 13: 'Preventing container loss'.[21] This bulletin focused on the risk of losing shipping containers at sea, the impact on safety and the environment, and what measures should be considered to prevent it from happening. Points raised in the bulletin included:

- The ship's crew must be familiar with, and containers must be stowed and secured in accordance with, the approved cargo securing manual
- Cargo securing arrangements should be regularly inspected and maintained and be sufficient to withstand severe weather conditions
- Preparations, including weather routing and adding lashings, should be made to ensure containers are secured for the most severe weather expected on the voyage.

### Port of Rotterdam, Netherlands

In 2019, in response to the loss of 342 containers from *MSC Zoe*, the Netherland authorities and Port of Rotterdam conducted a concentrated inspection campaign into 'Lashing of containers on board seagoing vessels'. The campaign involved random inspections of seagoing vessels in the

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[19] Available at www.amsa.gov.au

[20] AMSA focused inspection campaigns, see AMSA website: Historical focused inspection campaigns (amsa.gov.au)

[21] Available at www.amsa.gov.au

Port of Rotterdam to determine whether the loading and securing of containers complied with international laws and regulations.

A total of 69 ships were inspected. A significant proportion of the vessels (36%) did not secure containers according to their CSM, including heavy containers stowed over lighter ones.

The campaign included inspection for 'damaged portable/fixed lashing devices', and 11 vessels were found not to comply to international regulations in this area. No further detail was given and no specific mention of the damage or condition of fixed securing devices was made in the report. No vessels were detained as part of the campaign.

### *Classification society—DNV GL*

At the time of the incident, *APL England* was classified with DNV GL, was up to date with surveys, in class and had completed the most recent Annual survey during April 2020.

DNV GL advised that

> Annual survey is a general survey of the hull and equipment, machinery and systems to confirm that the ship complies with the relevant rule requirements and is in satisfactorily maintained condition. The thoroughness and stringency of the survey should depend upon the condition of the ship and its equipment.

Annual surveys were to include inspection of hull and equipment and machinery systems. DNV GL also advised that

> Hull and Equipment survey shall cover examination of as far as applicable…fittings and hull supporting structures…for stowage, securing and supporting of...containers (and) condition and origin/identity of loose lashing/securing elements, against documentation on board (approved container stowage plan).

DNV GL rules require that parts of the container stowage and lashing system fixed to the ship are subject to classification in accordance with Class construction rules. Loose lashing elements (lashing rods, turnbuckles, twistlocks etc) are to be examined within the approval of the entire stowage and lashing system in accordance with Class rules and recorded in the CSM.

The annual survey from April 2020 made no observations regarding cargo securing devices. This survey identified, among other items, heavy corrosion, wastage and cracking around a small number of cargo hatch coamings.

### *Protection and indemnity club insurance—Steamship Mutual*

A protection and indemnity (P&I) club is an independent, not-for-profit mutual insurance association, providing cover for its shipowner and charterer members against third party liabilities arising out of the use and operation of ships.

At the time of the incident, *APL England*'s P&I Club was Steamship Mutual. Steamship Mutual state[22] that

> …it is extremely important for the Club to manage the quality of entered tonnage in order to ensure that undue risk is not presented to the Membership as a whole by any particular entry.

To manage this, the Club conducted surveys of vessels prior to entry (if over 12 years old for container ships), as a result of a detention, a casualty or similar or as part of a programme of planned vessel surveys.

The purpose of these condition surveys was to examine risk, not only from the perspective of the physical condition of the vessel, but also with reference to shipboard operation and management. Club guidance for condition surveys of container ships included advice for surveyors to pay particular attention to, among others:

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22 Website: [Steamship Mutual - P&I Club - Home]

- Condition of cell guides
- Type, condition and sufficiency of container lashing equipment
- Condition of securing points on vessel
- Condition of shoes and twist locks
- Approved stowage plans, securing & lashing arrangement drawings as per CSM.

No evidence was made available to the ATSB by Steamship Mutual, or their representatives, to show that *APL England* had been inspected by the club during membership. Further, details of any inspections completed after the incident were not provided to the ATSB.

## Condition of securing arrangements

The ATSB examined securing arrangements and lashing equipment in use on *APL England*. The portable lashing equipment appeared in generally good condition. However, many of the ship fittings (fixed securing devices including lashing eyes, lashing bridges and deck structures) were in poor condition. Figure 7 (bay 30) and Figure 8 (bay 62) show examples of the condition of container lashing eyes and ship's structure from where containers were lost.

ATSB inspection showed this deterioration was apparent throughout the ship.

### *Corrosion*

The ATSB sought expert assistance regarding corrosion of marine and shipboard structures to understand the phenomenon occurring on board *APL England* and the resultant condition as illustrated above.

Advice received was that the environmental conditions of a ship's deck equipment and structures are complex and difficult to replicate for research purposes. Control over the conditions is difficult and research directly comparable to life-cycle conditions for container ship deck fittings is scant. That said, the advice was that corrosion of 25 mm steel plate to the state shown in Figure 7 and Figure 8 was high and was unlikely to have occurred in the 5 years between dry dockings. This was supported by corrosion research texts which suggested that corrosion rates of 1 mm per year were high.

**Figure 7: Typical, thinned, heavily wasted and failed double (left) and single (right) lashing eyes from bay 30**

Source: ATSB

**Figure 8: Thinned, heavily wasted and failed lashing eyes (top) and wasted and failed container support structure (bottom) from bay 62**

Source: ATSB

## Weather

As *APL England* travelled down the east coast of Australia, the master received weather information regarding a complex low pressure system developing off the south-east of the country. This included regular forecasts and warnings (including gale warnings) issued by the Bureau of Meteorology (BoM) through the automated Marine Safety Information (MSI) Enhanced Group Call (EGC) system, along with reports and guidance provided by the CMA CGM fleet navigation and support centre (FNSC) and through commercial weather guidance service providers (ship performance optimization system—SPOS).

### *Enhanced Group Call (EGC) communications*

*APL England* received and automatically printed the MSI broadcasts into the bridge as required. This included navigational and meteorological warnings, meteorological forecasts, and other urgent safety-related messages.

The printed messages were then filed on the ship's bridge. Ship's officers stated that in day-to-day operations they gave preference to consulting the weather and routing information regularly received from the FNSC and SPOS.

### *Bureau of Meteorology*

BoM provides marine weather services covering 78 coastal water zones around the coast of Australia. Additionally, forecasts and warnings to ships are provided via VHF and HF radio services, and the EGC MSI service through global satellite communications services. Services are also accessible via the internet.[23] BoM advised that forecasters ensure the most accurate information is provided in MSI bulletins by using multiple models and guidance sources.

On 20 May, as *APL England* entered the Coral Sea, the BoM was issuing storm force wind warnings (48–55 knots) for the south-eastern seas off Australia.

On 22 May, *APL England* was off the southern Queensland coast and received weather advice from the FNSC of a low pressure system off south-eastern Australia. The BoM issued storm force wind warnings throughout 22 May and into 23 May. At 1008 on 23 May the warning was reduced to a gale warning (34–40 knots). The gale warning remained into 25 May, well after *APL England* had lost the containers.

BoM also provided wind and wave forecast maps (to 7 days in advance) for the area. Daily copies of the wave maps and mean sea level pressure prognoses, from 11 May onwards, were sent to the master of *APL England* by the FNSC. These included forecast of 5–7 m waves on 23–24 May.

### *Ship performance optimization system (SPOS)*

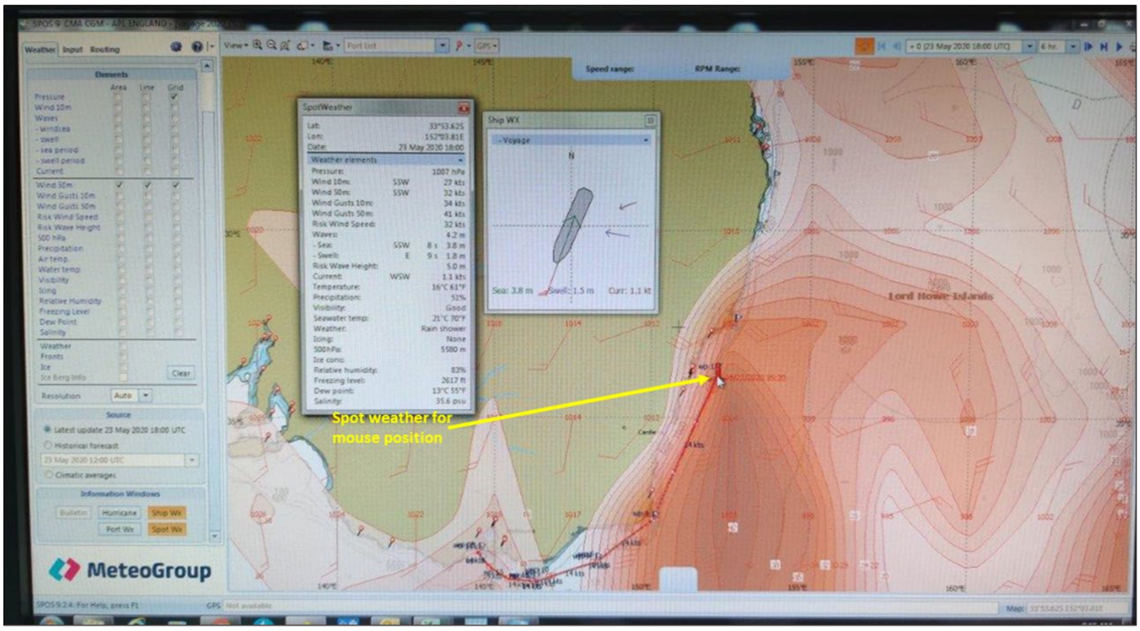
*APL England* was fitted with the DTN[24] ship performance optimization system (SPOS) weather routing software, with Seakeeping module. This module combined weather forecasts with hydrodynamic modelling and operational data from the ship for motion forecasting and risk assessment, based upon the IMO MSC.1/Circ.1228 guidance. This was to assist the master in optimising the ship's route. The service provided a data file sent to the ship via email which was accessed via on board software. Each file contained 9-day forecasting and could be received 1, 2 or 4 times per day.

On board *APL England*, the master stated that the latest SPOS data file was regularly downloaded and that they did so on 23 May. Figure 9 shows the update forecast map from 0400 on 24 May, used by the master to assess conditions. The ship weather inset graphic displayed the local weather conditions forecast for the ship at the time. The Spot weather inset listed the conditions at a point determined by the computer mouse pointer (in Figure 9, the mouse pointer was over the ship's position at 0220 hrs on 24 May).

The master stated that through experience they had come to rely more heavily on the information provided through the SPOS system than other means.

[23] Website: [Marine & Ocean (bom.gov.au)]
[24] In 2019 DTN and MeteoGroup merged to form one private weather company trading as DTN. See www.dtn.com/

**Figure 9: Weather map from SPOS data as used by the master prior to the incident**




*The figure is displaying APL England's position with projected route down the NSW coast. Displayed weather features include wind barbs, with coloured wind contours (clear to burned orange—user adjustable) and lines overlaying a grid of pressure readings. Insets show a list of spot (computer mouse position) weather conditions and the ship's weather graphic. The left hand side of the window shows the map elements available and those on display (checked). Note that times in the figure are in UTC.*
Source: APL, annotated by ATSB

## *Fleet navigation and support centre (FNSC)*

In 2017, CMA CGM opened a navigation and port operations centre in Singapore to provide 24-hour support to vessels operating in the Asia-Pacific region. The facility used the latest navigation assistance tools and technologies to track and examine wide-ranging nautical, meteorological, and geographic information in real-time and provided this support to the fleet's ships.

The FNSC advised, that for vessels trading between Asia and Australia, route planning was delegated to the ship's master using the on board SPOS software. That said, the FNSC also provided the ship with a daily weather forecast email covering the Australia-Oceania area. This email included the:

- Australian BoM mean sea level pressure prognosis charts for 12-hourly forecasts for that day and the following 3 days
- BoM Auswave Global total wave height and direction forecast charts for that day and the next
- Stormgeo[25] wind and wave forecast maps covering the Oceania region for that day and the next.

During the voyage to Australia, the FNSC monitored the progress of *APL England*. A route optimisation plan was sent to the ship after departure from Ningbo, to provide the master with guidance for improved fuel savings when transiting the Australian coast. On the master's request, the FNSC would also provide heavy weather avoidance advice in accordance with company procedures. No evidence of a request or any specific heavy weather advice from the FNSC was provided to the ATSB during the investigation.

Information sent by the FNSC, from 21 May onwards, forecast the high seas and heavy weather system developing in *APL England*'s path, off the south-east coast of Australia.

[25] Stormgeo (www.stormgeo.com) is a commercial weather information and advisory company. Its services to shipping include meteorological and data analysis and ship routing.

## Navigation in adverse weather

### *Possible causes of rolling*

IMO circular MSC.1/Circ.1228[26] provided masters with assistance for making ship handling decisions in adverse weather and sea conditions. The circular described adverse weather conditions that may cause heavy rolling with a risk of damage or capsize.

Dangerous phenomena detailed in the circular were:

- Phenomena occurring in following and quartering seas—not apparent in this case
- Synchronous rolling motion—when the ship's roll period[27] coincides with the wave encounter period.[28] Ships are more prone to such rolling when the seas are abeam.
- Parametric roll motions—large and dangerous roll amplitudes due to the variation of ship stability between the position on the wave crest and the position in the wave trough.
- Combination of various dangerous phenomena—extremely dangerous situations arising from combination of the above phenomena, with ship motion affected by waves and water on deck, cargo movement, and so on.

Operational guidance was provided to assist the master in avoiding dangerous situations when navigating in bad weather.

The circular cautioned that:

> A ship could be unsafe even outside the dangerous zones defined in this guidance if the stability of the ship is insufficient.

### *Procedures*

The bridge procedure 'Navigation in adverse weather' described adverse weather as 'unfavorable (sic) weather conditions which can lead to endanger the crew, the vessel and the cargo'. The procedure provided direction to the OOW and master for such conditions. Among other directions, the master was to inform the FNSC if support was required, and to report to the FNSC if the passage plan was to be amended.

The OOW was to monitor and assess the situation and use available information sources (including local observations and sources as outlined above) to minimise consequences of the adverse weather. The OOW was to advise the master of any significant happenings including changes in speed or course etc.

The procedure directed that at least once per watch, the master or OOW were to assess the weather using the 'Dangerous motion criteria' tool (described in the following section). Further, the 'Navigation in adverse weather check list' and the engine procedure 'Engine safety measures for adverse weather' were to be followed.

The procedure then included information on dangerous phenomena similar to that outlined in the IMO circular MSC.1/Circ.1228. This included synchronous rolling and parametric rolling. The advice and procedures were supported by the dangerous motions calculation tool.

The adverse weather procedures were not enacted during the voyage and deteriorating conditions. Further, as the weather worsened, the master did not direct the chief engineer or the

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[26] MSC.1/Circ.1228 Revised guidance to the master for avoiding dangerous situations in adverse weather and sea conditions

[27] Roll period (TR) was defined as 'The ship's natural rolling period when observing in calm sea.' This figure could be obtained from the load computer.

[28] Encounter period (TE) was defined as 'The time interval in seconds between the passages of two successive wave crests relative to a ship borne observer.'

duty engineer(s) to complete the engine room safety measures. Among other things, this procedure called for:

- the engine room to be continually attended
- main and generator engine sump levels to be adjusted to avoid loss of pump suction
- an additional steering pump to be running.

## *Dangerous motion criteria calculation tool*

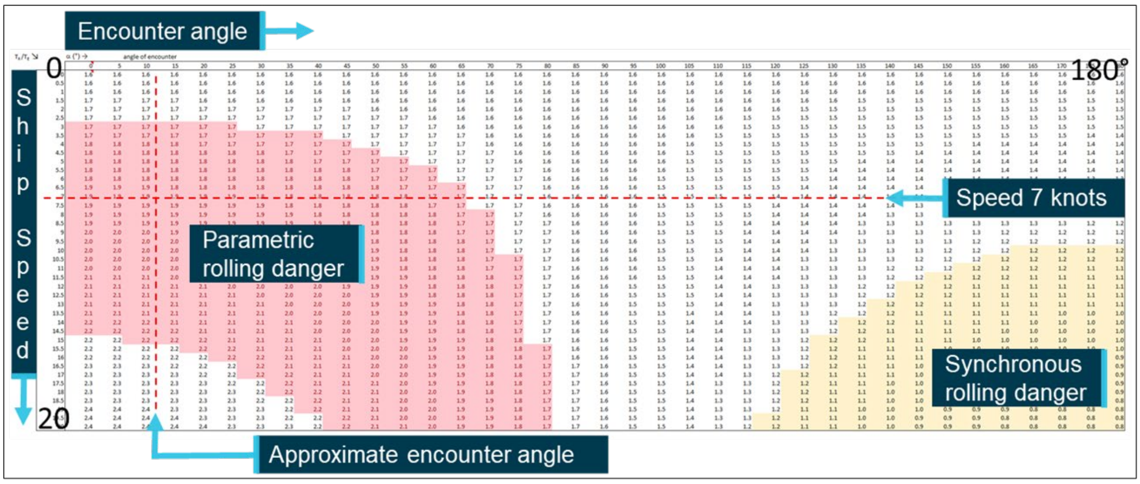
The dangerous motion criteria calculation tool determined the encounter period based upon values of the ship's speed, wave period and the angle between the ship's course and the wave direction. The tool then indicated if the master should be called due to the presence of one, or more, of the dangerous conditions (see Appendix: Dangerous motions criteria tool).

Using the formulae from the calculation tool and the conditions present at the time of the loss of containers, the ATSB constructed a map of encounter angle versus ship's speed for various values of the ship's roll period (TR) over the encounter period (TE) (TR/TE). The map (Figure 10) was used to highlight the conditions in which a danger of parametric or synchronous rolling existed. Also shown on the figure are the approximate speed and encounter angle existing at about 0610.

This representation indicated that, based on APL's criteria, *APL England* was operating in the region of susceptibility to parametric rolling. Of note, the criteria used to determine the ship's susceptibility to parametric rolling are independent of the state of the weather conditions. That is, these criteria do not vary with the size of the sea or waves or with deterioration in the state of the sea or weather, although the severity of the resulting rolling does.

The ATSB analysis showed that a significant alteration in a ship's course and / or speed would have been required to change the conditions such that the ship was not susceptible to parametric rolling.

**Figure 10: ATSB analysis map of dangerous rolling conditions for *APL England* based upon the dangerous motion criteria tool calculations**




Source: ATSB

## *APL England motion preceding the occurrence event*

During the hours preceding the loss of containers, as *APL England* pushed into the heavy weather, the ship went through intermittent periods of increased rolling. These events involved increases in the roll amplitude for several rolls after which the motion abated and more comfortable conditions returned.

One such event occurred at about 0215 on the morning before the loss of containers. At that time the ship was steering 200° and had a speed of about 7 knots, with winds from the south-west at force 8 (gale force 34–40 knots), sea state 7 (high seas 6–9 m) and a 4 m swell. The ship was proceeding comfortably when the amplitude of rolling increased for several rolls before reducing.

The rolling was sufficient to wake many crewmembers. It also moved furniture and unsecured items, and made standing difficult. The master went to the bridge to assist, and a machinery alarm called the duty engineer to the engine room. The alarm cleared on acceptance, but the duty engineer remained in the engine room and stayed there until about 0800.

These roll events precipitated a number of course changes and hand steering to attempt to reduce the amount of rolling and pitching. Several bouts of rolling, albeit not as severe, were experienced between 0215 and 0610, however the magnitude of the rolling at 0610 exceeded that encountered at 0215.

## Related occurrences

### *334-MO-2018-002 YM Efficiency, 1 June 2018*

At about 0035 on 1 June 2018, *YM Efficiency* was steaming slowly into strong gale force winds and very rough seas off Newcastle, en route to Sydney, when it suddenly rolled heavily, causing container stacks to collapse and topple. As a result, 81 containers were lost overboard and a further 62 were damaged. The ship sustained structural damage to its lashing bridges, superstructure, and accommodation ladder. Substantial debris from the lost containers subsequently washed ashore on the New South Wales coast.

The ATSB investigation[29] determined that the forces generated during the sudden, heavy rolling placed excessive stresses on containers stowed aft of the ship's accommodation. This resulted in the structural failure of containers and components of the lashing system, leading to the loss of containers overboard. Potential causes for the sudden rolling were investigated, but there was insufficient evidence to establish a definitive reason.

Further, the condition of the ship's lashing equipment was considered not to have contributed to the loss of containers. However, the investigation found that the weights and distribution of containers in the affected bays were such that calculated forces exceeded those allowable as defined in the ship's cargo securing manual.

### *APL England, 18 August 2016*

At about 1500 Western Standard Time[30] on 18 August 2016, while transiting the Great Australian Bight, *APL England* lost 37 containers overboard in rough seas. At the time of the occurrence, the ship was on an easterly heading (095°) at a speed of 17.9 knots in south-westerly winds of force 7/8 (34–47 knots) with a 4–5 m south-westerly swell on 6 m seas.

The master reported that the ship was rolling easily/moderately to a beam and quarterly swell but at around 1445–1500 the vessel encountered a sudden heavy roll to port (about 25°) coinciding with the loss of containers.

While the ATSB did not investigate this occurrence, AMSA conducted an investigation and concluded that:

- the vessel had a high GM which may have contributed to generation of excessive dynamic forces leading to failure of container base sockets and collapse of the stow
- the topmost container tier in all rows of the collapsed bay was over the recommended weight although the stack weight in each row was not exceeded

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[29] ATSB investigation 344-MO-2018-002: Loss of containers overboard from *YM Efficiency*, 16 NM east-south-east of Newcastle, New South Wales, 1 June 2018.

[30] Western Standard Time (WST): Coordinated Universal Time (UTC) + 8 hours.

- the master was well prepared for heavy weather and had complied with safety management system requirements on departure from Fremantle
- the weather experienced was as expected in the Great Australian Bight during the winter season
- the ship conditions (draft, loading, stability) were within criteria which may have led to parametric rolling.

The condition of fixed securing equipment on deck was not mentioned as a factor in this incident. *APL England* was subsequently inspected by AMSA in early 2017 and then departed the Australian coast and did not return to Australia until the current incident.

# Safety analysis

## Introduction

On 24 May 2020, *APL England* was making way down the east coast of New South Wales, with a cargo of containers, bound for Melbourne, Victoria. Early that morning, the ship underwent a series of heavy rolls in adverse weather, leading to failure of the container securing arrangements and the loss of 50 containers overboard.

Evidence indicated that the rolling, and resulting forces, exceeded the design limits for the securing system. However, *APL England*'s container securing arrangements on deck were in a poor state of repair and at risk of failing in a seaway below those limits.

The evidence also showed that the degree of rolling exceeded the design dynamic operating limits for the main engine and machinery. Consequently, the main engine lubricating oil pump momentarily lost suction causing the system pressure to fall below the low-low pressure main engine shutdown setting. The main engine shutdown and propulsion was temporarily lost.

## Heavy weather preparations

As early as 21 May, *APL England* received Bureau of Meteorology (BoM) reports of high seas gale and storm force wind warnings, issued through the enhanced group call automated communications system. At about the same time, the master received similar information regarding a low pressure system and high seas developing along the south-east coast of Australia, from supporting company and commercial weather services. The warnings continued over the following days.

In response, the master and crew undertook the following heavy weather preparations:

- container lashings were checked during the afternoon of 23 May
- the master spent increased time on the bridge with the navigating officers
- the master directed course changes and the use of hand steering to reduce the degree and effects of rolling and pitching.

However, the required adverse weather procedures and checklist were not followed and the dangerous motion criteria tool was not used.

The investigation was unable to state with certainty that compliance with the heavy weather procedures would have prevented this incident. However, not following procedures meant that opportunities to have been better prepared for the conditions encountered were missed.

Had procedures been followed, the master would have informed the fleet navigation support centre (FNSC) of local observations, navigation changes and ship conditions. The FNSC would then have been in a position to provide explicit, targeted, advice and support for avoidance of the heavy weather.

Furthermore, had the dangerous motions criteria tool been used, it would have indicated that the ship was in conditions conducive to parametric rolling and that greater changes to the ship's heading and / or speed were required to avoid the dangerous conditions.

In addition, if the engineering department had been notified of the situation, and completed the engine adverse weather procedure, the volume of oil in main engine and generator engine sumps would have been checked and, if necessary, increased. This would have reduced the likelihood that the main engine lubricating oil pump would lose suction, triggering a shutdown.

Finally, completing the adverse weather checklist would have ensured that all crewmembers were prepared for the conditions, followed the procedures, and used the tools. The checklist would also have prompted navigation checks and alterations which would have reduced the likelihood of the ship encountering rolling events to the extremes it did. It would also have reminded crewmembers of the need for other machinery preparations such as running an additional steering motor.

Given the condition of the deck, not completing adverse weather preparations in accordance with the procedure, exposed the ship and crew to increased risk.

## Vessel condition and maintenance

A well designed and effectively implemented maintenance management system not only helps a shipping company to meet the safety and pollution-prevention objectives, it is also an investment in the protection of a valuable asset.

Built in 2001, by 2020 *APL England*'s container securing arrangements on deck were in a poor state of repair and the strength of many securing fixtures, including in bays from which containers were lost, was severely compromised. For example, some of the lashing plates were reduced to less than 5 mm effective cross-sectional thickness from the original 25 mm plate (Figure 7 and Figure 8). The ATSB concluded that, in the seas encountered, the poor condition of these fittings contributed to the failure of many and the loss of containers overboard.

As the ship reportedly rolled beyond its design limit, the ATSB considered the possibility that the loss of containers was entirely due to forces associated with excessive rolling. However, as a factor of safety is applied to the securing fixtures, ultimate failure of these components should not occur close to the design limit if they are well maintained. On this occasion many of the fixtures securing the lost containers had been significantly reduced by corrosion, it was therefore considered likely that their poor condition also contributed to the incident.

It is also important to note that, in the sequence of events, it was not necessary for every single instance of lashing device failure to have been the result of corrosion. Any one failure of a lashing or, a combination of such failures could have imparted forces on adequately secured containers sufficient to dislodge them.

The severely corroded condition would have taken several years of poor maintenance to develop.

The investigation was unable to determine how the ship had come to be in this condition. Given the multiple inspection and maintenance arrangements in place, it was evident that *APL England* was not maintained to the standards expected by the industry and customers. Additionally, the ship had not received the scrutiny from shore management and agencies that a ship of its age or condition warranted. This presented an increased risk to the continued safe operation of the vessel and security of the cargo carried.

However, the evidence did not show that the condition of *APL England* was indicative of a wider problem with container ship condition. Container loss incident investigations and regulator inspection campaigns before and after this incident did not highlight poor condition of fixed securing devices as an issue.

## Loading of high cube containers into bay 62

For *APL England*'s voyage to Australia, bay 62 was loaded with 7 tiers of high cube (9 ft 6 in) containers. On the day of the incident, all containers in bay 62 above tier 4 (42 in total) were dislodged, of which 16 containers were lost overboard.

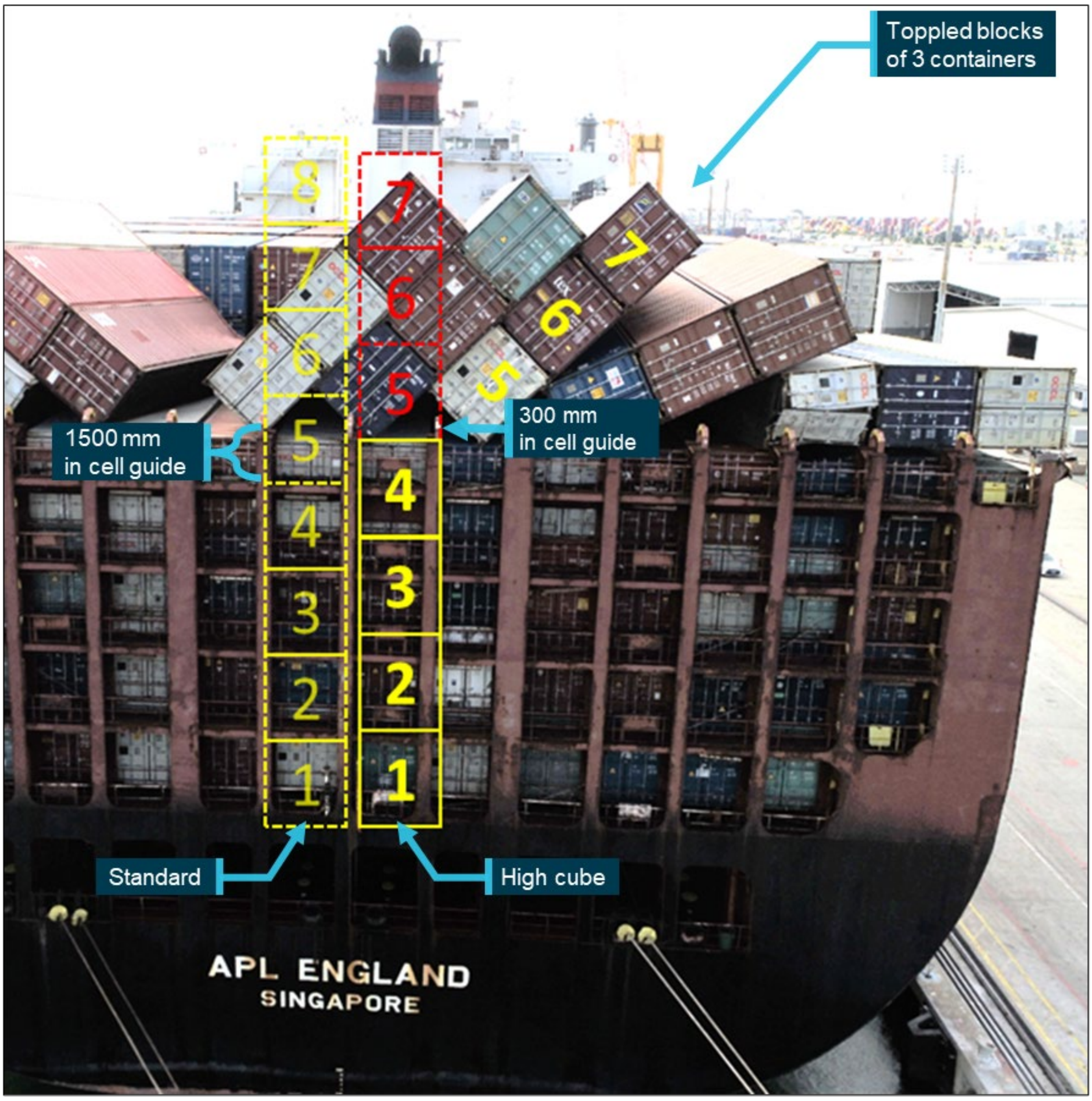
*APL England*'s cargo securing manual (CSM) only allowed 40 ft containers of standard height (8 ft 6 in) to be loaded into bay 62. Stowage in accordance with the CSM would have ensured that the lower 4 tiers of containers were securely held within bay 62's cell guide structure. It would also have ensured that about 1.5 m of the tier 5 containers were held within the cell guides, that is, over half of the tier 5 containers' vertical extent would have been secured within the cell guides. The CSM's lashing arrangements then called for the bottom of tier 6 to be secured to the top of tier 5 with twist locks and tier 7 to tier 6 similarly.[31] In addition, tiers 6 and 7 were to be secured by lashing rods and turnbuckles to lashing plates.

However, because the containers loaded in bay 62 were high cube (9 ft 6 in), loaded in contravention to the CSM and not detectable by the cargo computer software in use at time, the top of tier 4 was 1.2 m (4 ft) higher than if it the bay been loaded with standard height containers. Consequently, only about 0.3 m of the tier 5 containers were held within the tapered (fore-aft) lead-in section of the guides, which were themselves heavily corroded (Figure 5 and Figure 11). This left tier 5 containers with most of the container's height (about 2.3 m) protruding above the cell guide, resulting in them being virtually unsecured. The high cube containers in tiers 6 and 7 were then secured to tier 5 in the pattern described in the CSM (albeit intended for standard height containers). However, this meant that tier 6 and tier 7 containers were in turn secured by twistlocks to the virtually unsecured tier 5 containers and by lashing bars and turnbuckles attached to heavily corroded lashing plates. The combined effect was that the securing of the containers in tiers 5, 6 and 7 was inadequate.

Further, while containers in bay 62 were lashed in the pattern described in CSM, tiers 5 to 7 were higher than allowed for in the manual by virtue of being high cube containers. Consequently, lashing bar extension pieces were used to get the bars to reach the tops of the tier 6 and tier 7 containers. However, the extension pieces were not listed in the CSM, not part of the ship's lashing arrangements and therefore not approved for use on board *APL England*.

31 Containers within cell guides could not be secured together with twistlocks, nor was this required as the containers were considered secured within the cell guides.

**Figure 11: Bay 62 stack comparison between standard height and high cube containers**




Source: ATSB

## Cargo not stowed as per CSM

In addition to the factors discussed above, there were instances across the ship where container weights exceeded the maximum permissible weights allowed for in the CSM for that location. This included containers which were lost overboard.

In this incident, the weight discrepancies were not excessive (maximum being a 5.2 t container stowed in a location approved for 2.5 t) and the cargo computer calculated forces in these locations remained within limits. However, given the condition of the securing devices, any exceedance of the CSM recommended weight increased the risk of containers being lost.

# Findings

ATSB investigation report findings focus on safety factors (that is, events and conditions that increase risk). Safety factors include ‘contributing factors’ and ‘other factors that increased risk’ (that is, factors that did not meet the definition of a contributing factor for this occurrence but were still considered important to include in the report for the purpose of increasing awareness and enhancing safety). In addition ‘other findings’ may be included to provide important information about topics other than safety factors.

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

From the evidence available, the following findings are made with respect to the loss of containers overboard involving *APL England*, 46 NM south-east of Sydney, NSW, on 24 May 2020.

## Contributing factor

- While making way in adverse weather, *APL England* took on a series of very heavy rolls, which exceeded the strength of badly corroded fixed container securing devices. This led to the loss overboard of 50 containers.
- **The insecure loading of high cube containers into bay 62 was contrary to the ship's cargo securing manual and not identifiable by the cargo computer software in use at the time. Consequently, forces generated during the heavy rolling resulted in dislodging of all containers above the cell guides and the loss of 16 overboard. (Safety issue)**
- **A significant proportion of the fixed cargo securing devices on the deck of *APL England* were in poor condition. The heavy wastage of the devices significantly reduced their load carrying capacity and compromised the effective securing of cargo. (Safety issue)**
- **On board routine inspection and maintenance of fixed cargo securing devices on *APL England* was ineffective. Over an extended period of time, the significant proportion of the devices that were unfit for purpose were not identified and made good. (Safety issue)**
- For an extended period of time, the inspection regimes of several external parties with an interest in the condition of *APL England* were ineffective in detecting the deteriorating condition of the ship's deck structure and fittings. The external parties included shore management, Class, Flag, Port State Control and Protection and Indemnity insurers.

## Other factor that increased risk

- The ship’s crew did not follow the company procedures for adverse weather. This removed opportunities to take measures which would have better prepared the ship for the conditions encountered.
- The heavy rolling led to the main engine lubricating oil pump momentarily losing suction. This resulted in a loss of system pressure, and automatic shutdown of the main engine.
- In several instances, cargo was not stowed in accordance with the cargo securing manual. This resulted in container weights exceeding the maximum permissible in several locations.

# Safety issues and actions

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues. The ATSB expects relevant organisations will address all safety issues an investigation identifies.

Depending on the level of risk of a safety issue, the extent of corrective action taken by the relevant organisation(s), or the desirability of directing a broad safety message to the marine industry, the ATSB may issue a formal safety recommendation or safety advisory notice as part of the final report.

All of the directly involved parties were provided with a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

The initial public version of these safety issues and actions are provided separately on the ATSB website, to facilitate monitoring by interested parties. Where relevant, the safety issues and actions will be updated on the ATSB website as further information about safety action comes to hand.

## Loading of high cube containers into bay 62

### *Safety issue description*

The insecure loading of high cube containers into bay 62 was contrary to the ship's cargo securing manual and not identifiable by the cargo computer software in use at the time. Consequently, forces generated during the heavy rolling resulted in dislodging of all containers above the cell guides and the loss of 16 overboard.

| | |
|---|---|
| Issue Number: | MO-2020-002-SI-01 |
| Issue Owner: | APL CO PTE LTD |
| Transport function: | Marine: Shore-based operations |
| Current issue status: | Closed-Adequately addressed |
| Issue status justification: | The safety action taken adequately addresses the issues associated with the loading and securing of high cube containers in bays with cell guides, including the guidance provided in the cargo securing manual. |

### *Proactive safety action taken by APL Co Pte Ltd*

| | |
|---|---|
| Action number: | MO-2020-002-PSA-80 |
| Action organisation: | APL CO PTE LTD |
| Action date: | 23 November 2022 |
| Action status: | Closed |

APL notified the ATSB that, in consultation with DNV GL, an assessment of the safe stowage and carriage of high cube containers on the vessel had been completed. APL also conducted an internal safety assessment of the practice. As a result, limits were imposed on the numbers of high cube containers which could be loaded into bays fitted with cell guides.

This restriction effectively limits the extent to which containers protrude above the cell guides.

APL also notified the ATSB that the cargo securing manuals for *APL England* and similar fleet vessels were reviewed in consultation with DNV GL. The manuals were updated to include the revised stowage arrangements for high cube containers.

APL also advised that the wider CMA CGM Group and subsidiary entity fleets were made aware of this issue and the safety actions taken.

## Deck fittings in poor condition

### *Safety issue description*

A significant proportion of the fixed cargo securing devices on the deck of *APL England* were in poor condition. The heavy wastage of the devices significantly reduced their load carrying capacity and compromised the effective securing of cargo.

| | |
|---|---|
| Issue Number: | MO-2020-002-SI-02 |
| Issue Owner: | APL CO PTE LTD |
| Transport function: | Marine: Shipboard operations |
| Current issue status: | Closed-Partially addressed |
| Issue status justification: | The ATSB acknowledges the repairs that were undertaken to restore the integrity of the vessel's cargo securing devices. However, the ATSB also notes that, on departure from the shipyard, DNV-GL imposed a condition of class on the vessel in relation to the continued deteriorated condition of deck fittings. The condition noted that: 'Numerous corroded or thinned (components) were repaired...but still numerous corroded or thinned attached plates were not completely repaired due to time limited.' As such, the safety issue is considered to have been partially addressed. |

### *Proactive safety action taken by APL Co Pte Ltd*

| | |
|---|---|
| Action Number: | MO-2020-002-PSA-74 |
| Action organisation: | APL CO PTE LTD |
| Action date: | September 2020 |
| Action status: | Closed |

APL notified the ATSB that upon departing Australia, *APL England* sailed to a shipyard in Zhoushan (China) for assessment and repairs. The vessel remained in the shipyard for 30 days undergoing repairs, including replacement of the cell guides in bay 62.

Inspections by authorities confirmed the repairs and the ship was deemed seaworthy in September 2020.

Deck and container fittings in all other vessels in the APL fleet were inspected with some repairs required.

## Onboard inspection and maintenance

### *Safety issue description*

On board routine inspection and maintenance of fixed cargo securing devices on *APL England* was ineffective. Over an extended period of time, the significant proportion of the devices that were unfit for purpose were not identified and made good.

| | |
|---|---|
| Issue Number: | MO-2020-002-SI-03 |
| Issue Owner: | APL CO PTE LTD |
| Transport function: | Marine: Shipboard operations |
| Current issue status: | Closed-Adequately addressed |

| | |
|---|---|
| Issue status justification: | The safety action taken adequately addresses issues associated with management of the condition of deck fittings through routine inspection and maintenance arrangements. |

### *Proactive safety action taken by APL Co Pte Ltd*

| | |
|---|---|
| Action Number: | MO-2020-002-PSA-78 |
| Action organisation: | APL CO PTE LTD |
| Action date: | 23 November 2022 |
| Action status: | Closed |

APL notified the ATSB that the company had introduced a number of programs and actions for its fleet including:

- six-monthly detailed inspections of deck and container fittings with relevant Planned Maintenance Systems reviewed and updated
- regular vessel inspections by superintendents, which included determining a risk score
- updated fleet instructions related to main engine sump tank level requirements
- requiring a monthly condition report on deck fittings, including container fittings.

APL also advised that the wider CMA CGM Group and subsidiary entity fleets were made aware of this issue and the safety actions taken.

## Safety action not associated with an identified safety issue

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

### *Additional safety action taken by DNV GL*

During this investigation, the ATSB was advised that, at the time of the occurrence, there were no classification society rules specifically for the wear and tear and corrosion of fixed lashing devices. DNV GL advised that criteria for such were being developing.

In July 2022 DNV Class Guideline DNV-CG-0182[32] was updated to include a new section relating to container securing equipment.

This section provided requirements and guidance on allowable wear and tear of container supporting structures and container securing equipment. In this section the allowable corrosion limit of lashing eye plates varied from 10-20% of plate thickness depending upon the construction material.

### *Additional safety action taken by APL Co Pte Ltd*

APL notified the ATSB of additional safety action taken in regard to passage planning and navigation in heavy weather. A Safety Security Alert (SSA) was issued which advised masters to seek increased consultation with the Fleet Navigation Support Centre, emphasised deck and engine room preparations, and included reminders to comply with load software limitations and to refer to the appropriate procedures.

[32] DNV GL documentation is available through the website www.dnv.com. On 1 March 2021 DNV GL became DNV.

# General details

## Occurrence details

| | | |
|---|---|---|
| Date and time: | 24 May 2020 – 0610 EST | |
| Occurrence category: | Accident | |
| Primary occurrence type: | Cargo loss and damage | |
| Location: | 46 NM south-east of Sydney, New South Wales | |
| | Latitude: 34º 21.97' S | Longitude: 151º 54.78' E |

## Ship details

| | |
|---|---|
| Name: | *APL England* |
| IMO number: | 9218650 |
| Call sign: | 9VDD2 |
| Flag: | Singapore |
| Classification society: | DNV-GL |
| Departure: | Ningbo, China, 11 March 2020 |
| Destination: | Melbourne, Victoria, Australia |
| Ship type: | Fully cellular container ship |
| Builder: | Samsung Heavy Industries (South Korea) |
| Year built: | 2001 |
| Owner(s): | CMB Ocean 13 Leasing Company (Singapore) |
| Technical manager: | CMA CGM International Shipping Company (Singapore) |
| Gross tonnage: | 65,792 |
| Deadweight (summer): | 67,986.6 t |
| Summer draught: | 14.026 m |
| Length overall: | 277.255 m |
| Moulded breadth: | 40.00 m |
| Moulded depth: | 24.30 m |
| Main engine(s): | Samsung B&W 12K90MC |
| Total power: | 55,659 kW at 94 rpm (MCR) |
| Speed: | 25.0 knots |
| Injuries: | Crew – 1 minor |
| Damage: | 50 containers lost overboard, 63 containers damaged and remaining on board; vessel structure damage |

# Glossary

| | |
|---|---|
| AMSA | Australian Maritime Safety Authority |
| EGC | Enhanced Group Call—a service used for the broadcast and reception of marine safety information (MSI) messages to a group of ships or to ships in a specified area via the Inmarsat satellites. |
| FNSC | Fleet Navigation and Support Centre—part of CMA CGM's Navigation and Port Operations Centre in Singapore. The facility provides 24-hour support to company vessels operating in the Asia-Pacific region. |
| FSC | Flag State Control—the jurisdiction (flag State) under whose laws the vessel is registered or licensed has the authority and responsibility to enforce regulations over vessels registered under its flag, including those relating to inspection, certification, and issuance of safety and pollution prevention documents. |
| GM | Refers to metacentric height, one of the measures used to determine a ship's stability. |
| GMDSS | Global Maritime Distress and Safety System—an internationally agreed-upon set of safety procedures, types of equipment, and communication protocols used to increase safety and make it easier to rescue distressed ships. |
| IACS | International Association of Classification Societies— a not for profit membership organisation of classification societies that establish minimum technical standards and requirements that address maritime safety and environmental protection and ensures their consistent application. |
| ISM Code | International Management Code for the Safe Operation of Ships and for Pollution Prevention. |
| ISO | International Organization for Standardization |
| MPA | Maritime Port Authority of Singapore |
| MSI | Marine Safety Information—navigational and meteorological warnings, meteorological forecasts, and other urgent safety-related messages broadcast to ships. In Australia this is provided to vessels by AMSA and BOM as part of an internationally co-ordinated network of broadcasts. |
| MSQ | Maritime Safety Queensland |
| PSC | Port State Control—the inspection of foreign ships in national ports to verify that the condition of the ship and its equipment comply with the requirements of international regulations and that the ship is manned and operated in compliance with these rules. |
| SOLAS | The International Convention for the Safety of Life at Sea, 1974, as amended. |
| SPOS | Ship Performance Optimization System—commercial weather routing software for vessel route planning and updating. |
| TEU | Twenty-foot equivalent unit—a standard shipping container. The nominal size of a container ship in TEU refers to the number of standard containers it can carry. |
| UNCLOS | The United Nations Convention on the Law of the Sea—the regime of law and order in the world's oceans and seas establishing rules governing all uses of the oceans and their resources. |

# Sources and submissions

## Sources of information

The sources of information during the investigation included:

- the master and involved crewmembers of *APL England*
- APL
- Australian Maritime Safety Authority
- Maritime Safety Queensland
- Maritime and Port Authority of Singapore
- DNV GL
- the Bureau of Meteorology
- DTN
- Navis
- Port Authority of New South Wales
- Inchcape Shipping Services
- Transport Safety Investigation Bureau, Singapore
- the University of Newcastle, Australia
- Thynne Macartney

## References

International Maritime Organization, 2007, *MSC.1/Circ.1228—Revised guidance to the Master for avoiding dangerous situations in adverse weather and sea conditions*, IMO, London.

International Maritime Organization, 2014, *Code of Safe Practice for Cargo Stowage and Securing*, IMO, London.

International Maritime Organization, 2014, *MSC.1/Circ.1353/Rev.1—Revised guidelines for the preparation of the Cargo Securing Manual*, IMO, London.

International Maritime Organization, 2014, *The International Convention for the Safety of Life at Sea (SOLAS) 1974* as amended, IMO, London.

## Submissions

Under section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. That section allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the following directly involved parties:

- the master, chief mate, third mate, chief engineer, third engineer and the able seafarer on the helm, of *APL England*
- APL
- Australian Maritime Safety Authority
- Maritime Safety Queensland
- The Maritime and Port Authority of Singapore

Submissions were received from:

- the master, chief engineer, third engineer and the able seafarer on the helm, of *APL England*

- APL
- Australian Maritime Safety Authority
- Maritime Safety Queensland
- The Maritime and Port Authority of Singapore

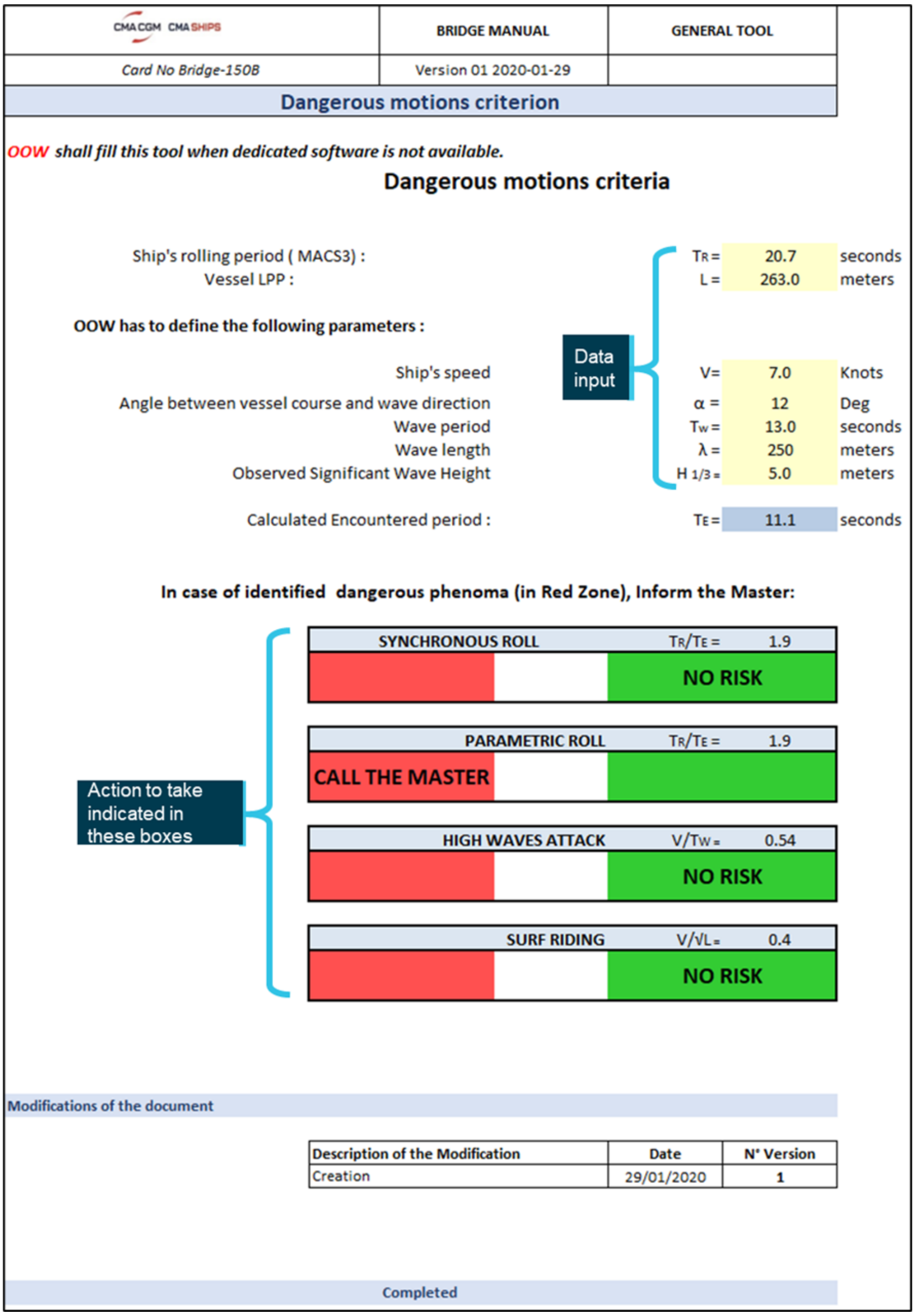
The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.

# Appendix

## Dangerous motions criteria tool

The CMA CGM bridge manual procedure ‘Navigation in adverse weather’ required that ‘The Master or OOW shall assess the weather condition, at least, once a watch by using the…Dangerous Motion Criteria’. This requirement was included as an item in the ‘Navigation in adverse weather checklist’. Output from the tool, including any action to take, was indicated in red and green boxes (Figure 12).

**Figure 12: Dangerous motions criteria tool**



| CMA CGM CMA SHIPS | BRIDGE MANUAL | GENERAL TOOL |
|---|---|---|
| Card No Bridge-150B | Version 01 2020-01-29 | |

**Dangerous motions criterion**

*OOW shall fill this tool when dedicated software is not available.*

**Dangerous motions criteria**

| | | | |
|---|---|---|---|
| Ship's rolling period ( MACS3) : | TR = | 20.7 | seconds |
| Vessel LPP : | L = | 263.0 | meters |
| **OOW has to define the following parameters :** | | | |
| Ship's speed | V= | 7.0 | Knots |
| Angle between vessel course and wave direction | α = | 12 | Deg |
| Wave period | Tw = | 13.0 | seconds |
| Wave length | λ = | 250 | meters |
| Observed Significant Wave Height | H 1/3 = | 5.0 | meters |
| Calculated Encountered period : | TE = | 11.1 | seconds |

Data input

**In case of identified dangerous phenoma (in Red Zone), Inform the Master:**

| | | | |
|---|---|---|---|
| SYNCHRONOUS ROLL | TR/TE = | 1.9 | NO RISK |
| PARAMETRIC ROLL | TR/TE = | 1.9 | CALL THE MASTER |
| HIGH WAVES ATTACK | V/Tw = | 0.54 | NO RISK |
| SURF RIDING | V/√L = | 0.4 | NO RISK |

Action to take indicated in these boxes

Modifications of the document

| Description of the Modification | Date | N° Version |
|---|---|---|
| Creation | 29/01/2020 | 1 |

Completed

Source: APL, annotated by ATSB

# Australian Transport Safety Bureau

## About the ATSB

The ATSB is an independent Commonwealth Government statutory agency. It is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers.

The ATSB's purpose is to improve the safety of, and public confidence in, aviation, rail and marine transport through:

- independent investigation of transport accidents and other safety occurrences
- safety data recording, analysis and research
- fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia, as well as participating in overseas investigations involving Australian-registered aircraft and ships. It prioritises investigations that have the potential to deliver the greatest public benefit through improvements to transport safety.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, international agreements.

## Purpose of safety investigations

The objective of a safety investigation is to enhance transport safety. This is done through:

- identifying safety issues and facilitating safety action to address those issues
- providing information about occurrences and their associated safety factors to facilitate learning within the transport industry.

It is not a function of the ATSB to apportion blame or provide a means for determining liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner. The ATSB does not investigate for the purpose of taking administrative, regulatory or criminal action.

## Terminology

An explanation of terminology used in ATSB investigation reports is available on the ATSB website. This includes terms such as occurrence, contributing factor, other factor that increased risk, and safety issue.